Shelve

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On the Harvest Bug.

(*Trombidium Autumnale.*)

By the late J. J. Wright, M.D., Edinburgh.

(*Read Sept. 24th,* 1869.)

In many country houses, at this season of the year, among the many minor miseries of life, not the least is that caused by the Harvest Bug. They are extremely partial in the distribution of their attentions. Many people are never bitten by them, others suffer a martyrdom from their attacks. As far as my own observations extend, females suffer more than males, which may arise simply from the greater protection afforded by the dress of the latter. The Harvest Bug is most abundant in autumn, and it rarely appears before June or July. They are especially plentiful on the leaves of the raspberry, the French bean, and in the stubble fields. They seem to have most partiality for the chalk formations; for example, they are abundant on the chalk formation of the Yorkshire Wolds, but very rare on the low lands at the foot of the hills. Gilbert White in his "Natural History of Selborne," tells us, "The warreners are much infested by them on the chalky Downs, where these insects swarm sometimes to so infinite a degree as to discolour their nets, and to give them a reddish cast, while the men are so bitten as to be thrown into fevers." The Harvest Bug is also said to attack the lower animals, such as sheep, dogs, horses, and rabbits.

It is probable that the Harvest Bug is the young, or immature form of some species of tick, which bury their suckers so firmly in the skins of the animals they infest, that they can rarely be pulled away without injuring the parasite, or tearing the skin.

The Harvest Bug is of a bright red colour, looking, when upon the surface of a leaf, or a dark dress, not unlike a very minute grain of cayenne pepper. Its form is oval, or rather egg-shaped, the anterior extremity representing the small end of the egg. The head is oval, and attached to the abdomen without any intermediate neck, or constriction. Two lancets project from the anterior part of the head; they are curved and lancet shaped; the point of each projecting forwards and outwards, and diverging from the one on the opposite side, so that the convex edges are directed towards the mesial line. Just below the point of each lancet, a line commences and runs downwards to the centre of its base. At the under surface of the head, just at the base of the lancets, is a tubular proboscis, mouth, or sucker, which can probably be projected forwards between the two lancets after they have pierced the skin. On each side of the base of the lancets is a projecting eye, a dark looking spot occupying the centre. External to the eyes are the conical shaped mandibles, attached by a broad base to the under surface of the head, and terminating in two or three bristles, one of which appears to be much stouter than the others. The abdomen is rounded and covered sparingly with long, curved, and rather delicate hairs, which project posteriorly beyond its outline. In the young state, the state in which it is generally found, the insect has six legs. After moulting, it is said to acquire an additional pair. The legs are jointed, covered with longish hairs, and terminate in three long, curved hooks. The entire insect is extremely soft, delicate, and easily crushed by a very slight pressure.

In all the books I have consulted, it is said that these insects burrow in the skin of those whom they attack, and that a raised wheal is caused by their presence in, or beneath the skin. This quite coincides with the popular opinion; but I believe it to be entirely erroneous, and for the following reasons. It is difficult to conceive that a parasite, having such an external form as we have just described, could penetrate a texture so dense as that of the human skin. I have repeatedly, and very carefully examined with a powerful lens, the raised spots, or wheals, without finding the slightest trace of an opening or track, along which the insect may

have been supposed to pass, such as the red line, or burrow of the itch insect when it leaves its pustule. They may sometimes be observed adhering to the skin at the top, and centre of the wheals, after these are fully formed; at a period therefore, when, if they burrowed, they might be supposed to be concealed from view. When examined on the skin, the head, or part of the head is sometimes seen partially covered with an epithelial scale; and this is the nearest approach to burrowing which I have ever noticed. When observed upon the skin it gives the impression that the lancets are buried in its substance, while the mandibles and claws firmly grasp the hairs, or inequalities on the surface of the skin. They are extremely difficult to remove without completely crushing them, so tenaciously do they adhere. No central puncture can be detected in the wheal, as in the case of the bite of a bug, flea, or gnat: and this may perhaps be urged as a reason for supposing that the lancets of the Harvest Bug do not pierce the skin. But its lancets are extremely small as compared with those of the insects just mentioned, and they are so arranged as to make an essentially different kind of opening. Penetrating the skin directly downwards, and then diverging in the same plane, they will make something like a simple incision, which from its form, and extreme minuteness, and from its tendency to close accurately the moment the lancets are withdrawn, would be far more difficult to detect than the large and circular puncture of the flea. Further, if the wheal from the sting of a nettle be examined, which is extremely like that produced by the bite of the Harvest Bug, it is impossible to detect the point at which the sting has penetrated, though we are quite sure there *has* been a penetration, and the injection of an acrid fluid. Again, it may be objected, if the incision be so minute and simple in its form, why should it excite irritation so severe? I suspect, though this is certainly only a conjecture, that an irritant fluid is poured into the wound through the minute line, or tube, which passes through the centre of the lancets. This line appears to me to bear a strong analogy to the hollow tube which passes through the fangs of the spider, and which we know to be connected with a poison sac. That an acrid fluid is injected is also rendered the more probable from the striking resemblance between the effect produced by the sting of the nettle, and the bite of the Harvest Bug. Suppose the insect *does* burrow beneath, or embed itself in the skin, what is the object to be accomplished? It neither deposits its

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eggs there, nor does it undergo any further development, as in the case of the itch insect for example, and some other parasites. If the Harvest Bug were allowed to remain undisturbed on the human skin, which, however, is to suppose almost an impossibility, I imagine it would pierce the skin with its lancets, protrude its proboscis into the opening, and quietly suck the fluids required for its nutrition until it underwent a further development, becoming possibly a true tick.

The above remarks are not intended as anything like a complete history of the Harvest Bug; but they are designed to direct attention chiefly to the structure and supposed burrowing habits of the insect. There are many points in its history and development which are altogether unknown, and which I could have wished to investigate, had not the state of my health precluded the possibility of further observations. Hitherto, in the books which I have consulted, I have not seen either a good description. or a correct plate of the Harvest Bug. The subject may possibly have sufficient interest to engage the attention of some of the members of this Society.

Malton, Sept. 6, 1869.

Dr. Braithwaite objected to the name "Trombidium" being applied to this insect, that being the generic name of the common red earth mite, which he believed to be a totally distinct creature. He suggested "Leptis" as being more correct, and pointed out that the six legs of the Harvest Bug do not of necessity indicate it to be a larval condition, degradation of type being found in all classes.

Mr. M. C. Cooke said that he thought a figure of this creature would be found in Koch's "Arachniden," and in Kuchenmeister's "Parasites." He could not agree with Dr. Braithwaite that there was any evidence of its being a perfect insect. It was agreed by most zoologists that although we do not know anything of a further development, that its manifest affinities are with the larval forms of Acarina, and that it doubtless belongs to the section Trombididæ, which, in the larval form, have six legs. There is a species of *Hydrachna* found adhering to the legs of certain *Tipulæ*, and also those of Dragon-flies whilst in the hexapod state; but when these take upon themselves the octopod condition they are purely aquatic.

So with this creature, it may afterwards become aquatic, or pass to some other and different mode of life, in which its prior condition may not be suspected, and which, of course, has not been traced. Professor Westwood, some time since, directed the attention of the members of the Entomological Society to certain immature specimens of Tick which he had found in a dog kennel, but in the hexapod state they possessed such close affinities with the octopod condition of *Ixodes* that there was no difficulty in recognizing them. There is no good ground, therefore, for presuming that there is any connection between Harvest Mites and Ticks, even in the hexapod state.

On the Use of the Microscope as an Aid to the Classification of Animals.

By B. T. Lowne, M.R.C.S. Eng.

(Read October 22nd, 1869.)

There are several ways in which the microscope has afforded important aid to us in studying the relations of the various classes and species of animals to each other. Its uses in discriminating the affinities of the minuter forms of life, and in examining minute organs, are too obvious to need enlarging upon. Again, the facts brought to light by means of the microscope, especially during the past few years, in the embryology and development of animals, have been of the utmost importance.

It is not, however, to such classes of facts as the above that I intend to draw your attention to-night, but to a hitherto unworked field of enquiry.

I believe histological structure, that is, the form and structure of the ultimate elements of the bodies of animals, is destined to afford an important clue to their relations to each other, and will perhaps, when closely studied, go far to settle the great zoological question of the day—how far animals and plants are related to each other by descent.

Perhaps it is almost premature for me to speak of this subject to-night, but its issue is so important, and the facts I have to bring before you are so suggestive, that I cannot refrain from saying a few words upon it.

On a *primâ facie* view, the histological structures of all animals appear to be identical; for instance, the epithelial cells of molluscs, insects, and vertebrates present the same essential characters. I do not know of any means by which the conical epithelium of the stomach of an insect could be distinguished from that of a man, nor do I know any mode by which gland cells, pigment cells, or muscular fibres belonging to one class of animals, could be distinguished from those of another class.

It is by means of this close resemblance of tissue that we are mainly enabled to judge of the functions and characters of the

organs of the invertebrata, especially where they differ materially (as they usually do), in their structure and appearance from those of vertebrates. In fact, I know of no other sure guide to function except histological structure.

It is true that the histological tissues of the lower forms of life frequently exhibit characters which belong to the same structures in higher animals, whilst yet in an undeveloped or embryonic condition. For instance, muscles appear to be developed by the fibrillation of proto-plasm, and in such forms as the higher Hydrozoa, the muscles consist merely of proto-plasm, exhibiting indications of fibrillation. The existence of nuclei in the muscles of insects has been ascribed to a similar undeveloped condition, but must, I think, be attributed to rapidity of growth rather than to any arrest of development, since the muscles of insects exhibit the utmost perfection of structure, and the nuclei are often absent when the insect has reached maturity.

Rapidity of growth seems to have an important influence on the character of all histological tissues, and as far as my observations go, tends to increase the size of the ultimate elements of the fabric very materially; for instance, the muscular fibres and gland cells of the larvæ of insects, are often nearly ten times as large as the same structures in the perfect state. It has been repeatedly stated that the muscles of insects have larger fibres than those of vertebrates,—such is the case in the rapidly growing tissues of the larva, but I have repeatedly found muscular fibres in insects as small as $\frac{1}{5000}$ of an inch in diameter, which is nearly as small as any known fibres.

I do not know any more important tissue than muscle, nor any which presents so complex a problem in its distribution and development in different animals.

Two kinds of muscle have usually been described; these are known to anatomists as the striated and non-striated varieties. The structure of striated and non-striated muscle differs very materially, the former consists of bundles of fibrillæ of very minute diameter, bound together in a membranous sheath so as to form a muscular fibre, a number of muscular fibres constituting a muscle. The fibres exhibit regular transverse striæ; and when the fibres are broken up by the rupture of the myolemma or sheath, the fibrillæ of which they are composed present the appearance of minute fibres, presenting alternate dark and light spaces, so that each of

these fibrillæ appears to be made up of a number of alternate cylinders of greater and less opacity. The non-striated muscles consist of more or less elongated fusiform cells, exhibiting distinct nuclei, or of long fibres bulging at intervals, and exhibiting nuclei in the swollen spaces.

In the Vertebrata, these two forms of muscle are constant in their occurrence; the former in all the muscles of the body, which serve the purpose of locomotion as well as all ordinary voluntary, or reflex acts; the latter constitute the muscular coats of the viscera and blood vessels, except the heart, which has its muscular walls composed of the striated variety of muscle.

In the Mollusca and Insecta the case is however far different; in the former the non-striated, and in the latter the striated varieties enter into all the muscles, almost without exception; thus, the walls of the stomach and intestines of insects exhibit the striated kind, whilst the elaborate muscular system of the Cephalopoda is entirely composed of non-striated muscle.

In the Annelida again, which forms a large division of the Annulosa, and which present many characters which show their close affinity to insects, the non-striated muscle only exists,—whilst the Ascidians, a group of the Molluscoida, according to the best authorities, possess striated muscular fibres.

This irregular distribution of striated and non-striated muscle is worthy of careful consideration, but especially in relation to the origin of species; much has yet to be done in working out the relation of the one kind of fibre to the other. To say the least, it is a fact yet to be accounted for by those who believe in the descent of several types from a common ancestor.

Other facts of a kindred nature might be carefully worked out, and the results of such investigation may have the most important issue.

The close resemblance of the Spermatozoa of the most widely separated groups of animals, and their great diversity of form and size in nearly allied types, are facts, the import of which are at present not understood. The apparent identity of nerve cells and fibres in the most diverse types, together with the strange manner in which the different kinds of muscular fibres are distributed, the absolute unity of structure existing side by side with the greatest diversity of type and form, are all facts bearing upon the same great problem. I commend them to your notice, gentlemen, feeling

sure that they present fruitful fields of enquiry to every naturalist, and I hope many years will not elapse before I shall be in a position to lay something much more tangible upon this important subject before you.

I would suggest, in conclusion, the immense advantage of numerous workers in this branch of research, and that each of you who are conversant with the different varieties of tissue, should take every opportunity of making such observations as opportunities occur, whilst reports of all such researches, even if they extended only to some single species, and even to a single tissue, would form most valuable notes, and be a great addition to the Journal. Elaborate papers are not necessary, so that each member will bring the note of a single careful observation.

On Some Portions of Skin, supposed to be Human, found on a Door in Westminster Abbey. By Henry F. Hailes.

(Read October 22nd, 1869.)

I have placed under a microscope upon one of the tables an object which may be considered rather as an archæological than a microscopical curiosity. It is a portion of skin taken from one of the doors of Westminster Abbey. Some explanation is necessary in order to make this object intelligible; I have therefore gathered together a few particulars, chiefly from Dean Stanley's "Memorials of Westminster Abbey."

In the eastern cloisters of Westminster Abbey is a door which is never opened except in the presence of the Secretary of the Treasury, the Chancellor of the Exchequer, and the Comptroller of the Exchequer. This door leads into a chamber in the old Norman substructures, beneath the original dormitory of the monastery.

This chamber is the Treasury of England, of which the Prime Minister is the First Lord and the Chancellor of the Exchequer the administrator. It it now better known as the "Chapel of the Pyx."

In this chamber were kept, up to the year 1303, the choicest treasures of the State; the Regalia, sundry relics, and a large hoard of money.

In the year 1303, the King (Edward I.) being at Linlithgow, this treasure was carried off by thieves. The chief robber appears to have been one Richard de Podlicote, who, having previously broken into the Chapter-house and robbed the Refectory of a large quantity of plate, had thus ascertained the precise position of the Treasury, and afterwards concerted with his friends (some of whom were within the precincts of the Abbey), and with their aid carried out the robbery.

The treasure, after it was taken out, was concealed in some hemp (planted it is believed for that purpose) growing in the cloisters, and was afterwards conveyed in two black panniers across the river to the "King's bridge," by the monk Alexander of Pershore and others.

The abbot and the eighty monks residing in the Abbey, were taken to the Tower and tried, but were all released with the exception of the sub-prior and the sacrist.

The approach to the Treasury from the north side was walled off, and the Treasury thus reduced in size. Inside and outside of the door by which this passage is entered is nailed the skin of a man. The door of the Sacristy, in the south transept of the Abbey, has also been decorated in a similar manner.

The more valuable part of the treasures was thenceforward kept elsewhere, and the "Pyx Chapel" was used only to keep the Regalia, relics, some records, and the "Pyx," or box containing the dies of the coin of the realm. The Regalia have since been removed to the Tower, the relics were probably destroyed at the Reformation, and the chamber is now used, I believe, only for the "Pyx," and for the standard weights and measures. It is guarded with great care, and only opened once in five years, as before said, by the Prime Minister, Chancellor of the Exchequer, and the Comptroller of the Exchequer, for the time being, with much ceremony.

The fragments of skin exhibited are from the door leading to the "Pyx Chapel." They clearly show the roots of hairs; certainly more resembling those of the human body than they do any other animal that I know of, but they do not appear to me to be those of a "fair-haired man," as asserted by Dean Stanley. This, however, would rather tend to bear out his theory, that these skins are not those of sacrilegious Danes as is generally supposed, but are more probably the skins of those concerned in the robbery. We are not informed what was the fate of Richard de Podlicote and his accomplices, but it seems probable that they were executed, and that the sacrist's skin was displayed upon his own door, whilst the other two may have served to line the inside and outside of the door leading to the Pyx chamber.

A Simple Form of Selenite Stage. By W. Hislop, F.R.A.S.

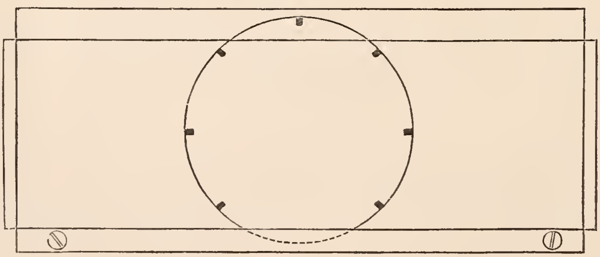
(Read Nov. 26th, 1869.)

A short time since I endeavoured to point out the necessity of a closer attention to the mechanical arrangement of the polariscope as applied to the microscope, in order to render the advantages of illumination by polarized light, more generally available. As a contribution to this end, I described a piece of apparatus which I had contrived, used, and exhibited for some time, and which I called an Analyzing Selenite Stage; the arrangements of which were so contrived as to contain three separate films of selenite, and to give them the power of rotation *in all directions, together or separately, and in close contact* with the object under examination. The facility with which this could be done, and the proper effect produced and registered for each object was also pointed out.

Since then the use of that instrument has produced some curious results, and the simple arrangement which I have now to describe is one of them, and will, I think, greatly increase the range of the ordinary forms of polarizing apparatus, without the necessity of incurring the expense of more elaborate contrivances.

I merely avail myself of a previously known fact—namely, that if a film of mica be superimposed on a film of selenite, the colour transmitted by the latter will be much modified. I find that if we take a film of selenite producing, say, a blue colour, and if we superimpose on that a film of mica, of say ·002 in thickness, and separate their axes of polarization by a certain angle, we obtain by the combination nearly all the colours which we have got by different films of selenite. I cannot fix the exact angle of divergence, as it varies with different specimens of mica, but it is easily ascertained by trial.

To make this compound film available, I use first an ordinary brass slide about 3 inches by $1\frac{3}{8}$ of an-inch (*See Fig.*), with a ledge at the



lower side. The central portion of the slide is turned out with a flange, so that a brass ring may be made to revolve in it easily. The film of selenite, and the film of mica are cemented into this ring in the proper relative position to give the desired effect, and eight notches are cut in the edge of the disc. When the mounted object is placed on this brass slide, the edge of the disc projects beyond the slip, and it is easy to turn it through a portion of a revolution without disturbing the object, by using a hooked wire or even the point of a penknife.

If now the colour given during the rotation of the analyzer be blue and yellow, by simply turning the disc holding the compound film through one-eighth of a revolution these colours will give place to their complementary ones, namely,—red and green; and they will be given as brilliantly as they can be obtained by more complicated arrangements. Intermediate positions give other tints.

Further, this contrivance enables us to employ that most effective element, namely, the rotation of the depolarizing film to suit the various planes of double refraction in the object under examination, and it does this in an easy and inexpensive manner.

On the Different Methods of Measuring Microscopical Objects.

Memoir by Count A. F. Castracane d' Antelminelli.

(Read November 26th, 1869.)

It is not only to those who contemplate the immensity of the celestial bodies, or the wonderful harmony of the stars, and of their movements, that it is given to feel themselves transported with amazement when reflecting on the infinite wisdom of the Creator. The earth and the sea, under whatever aspect they are regarded, and even in most minute details, give evident proof that all proceeds from the same infinite, ordaining Mind. Or rather, all that proceeds from the hands of the highest Artificer cannot but be equally stupendous in itself, so that man feels himself compelled to marvel more when he reflects on the organization of the most humble flower of the field, or on the structure of the smallest fly, than he does at the sight of an aged oak, or at the immense bulk of an elephant. Hence, we can safely say that there is no more ineffable or purer pleasure than that which is afforded to him who, with the aid of the microscope, investigates the marvels of minute structure so eminently calculated to exalt the mind to the admiration of Infinite Creative Wisdom.

However, the micrographical observer does not have the gratuitous enjoyment of his satisfaction, since he has very often to encounter difficulties which must be overcome, aud has inevitable annoyances to bear. Among other things, the microscopist, and especially one who attends to the study of the Diatomaceæ, finds himself constantly obliged to take and to register the measures of the objects which he has before his eyes, and to calculate the minuteness of details, which are often so small that more than a thousand could be contained in the space of a millimètre.

For taking these measures and computing the wonderful smallness of these particles, numerous are the means at the disposal of the student, who, with different methods and by different ways, can attain his desired object with more or less facility and exactitude; and of these I intend to treat. On such a subject I do not pretend to say anything new; I shall only rewrite, in a few words, as

much as I have been able to collect from the best treatises which have been written on the subject: I shall, however, speak from experiments made by myself, to which I have united a few practical particulars which from time to time I have ascertained to be the most useful. I hope however, it will not be altogether useless to make known the means I make use of, thus, as it were, clearing the way for those who wish to undertake similar researches, or who wish to become expert in the use of the microscope.

From the first moment when I undertook the study of the Diatomaceæ, I was induced to occupy myself with their measurement as one of the data which might serve for the determination of the species, and for the identification of the subjects which I had under my eyes, with the species described in Smith's Synopsis of the British Diatomaceæ, and in the works of Kützing, Rabenhorst and others. The easiest system for taking such measurements is that founded on the use of the Camera Lucida, an invention which is due to the celebrated English savant, Wollaston, in 1807, which has been successively modified and perfected by the illustrious German anatomist, Sœmering, the French opticians, Chevallier and Nachet, and the Italian Professor, John Baptist Amici, whose name is connected with nearly all the improvements in the microscope.

The Camera Lucida consists essentially of a reflecting surface, which forms an angle of forty-five degrees with the axis of the microscope, which surface must be such as to permit the simultaneous view of the object disposed in the field of the instrument, and of the plane on which the same image is reflected. It is then extremely easy for anyone whose hand is trained to the use of the pencil, to draw, by these means, the object under observation, following all the contours, and making, as it were, a tracing. Sometimes, however, he finds some difficulty in seeing with ease, at the same time, the reflected image, the contour already drawn, and the point of the pencil which is completing the drawing. This inconvenience arises from the want of a just relation between the illumination of the field of the microscope and that of the plane on which he is drawing. Thus, if the former is very much illuminated and the paper in shade, it will be difficult to have a simultaneous view of the object and of the drawing he is making. Such an inconvenience must be carefully obviated by diminishing the concentration of the light in the field, or by selecting a position in which the plane on which the drawing is being made will be better illuminated.

Having completed by this method the drawing of the object, or simply indicated the extremities, the application of a metrical measure will immediately give the dimensions, increased precisely in proportion to the magnifying power used in the microscope; from which it results that the real size of the object is equal to the apparent size divided by the magnifying power, in diameters. It is, however, essential to remember, that in order to obtain with the Camera Lucida, a drawing corresponding in dimensions to the increase obtained in the field of vision, the distance from the reflecting point to the plane in which the drawing is being made must be precisely equal to the distance from the same point of the object under observation; while the drawing and the measure which is deduced from it will be greater or smaller than the dimensions presented by the object in the field of the instrument in proportion as the height of the Camera Lucida from the plane of the drawing may be greater or less than is correct.

Such is the most prompt and most practical method of determining the dimensions of objects which are observed under the microscope. Still, such a determination is a thing of very little importance, if not even a mere matter of curiosity. The same cannot be said, on the other hand, of the number of striæ, or rows of dots, or of cells, which may occupy a given space on the surface of the observed object. Although up to the present time those who are engaged in observing the Diatomaceæ are not agreed in recognising the importance of such a datum in regard to the value it may have as a diagnostic character, yet it is generally acknowledged that, at any rate, within certain limits of variableness, the number of the striæ which cover the valve of a Diatomaceæ, is one of the means of identification of the species to which it belongs. It is, however, useless to trust to the means of the Camera Lucida for determining the thickness of the striæ, so close together and so fine are they; for this purpose it is necessary to have recourse to means of much more exquisite delicacy.

A process answering better for this purpose is found in the use of the eyepiece micrometer, which is nothing but a measure adjusted to the eyepiece, from which measure is determined the value, in relation to the magnifying power used by means of a millimètre cut on glass, and divided into hundredths and placed under the objective. The commonest form is that of a thin plate of glass, on which is engraved a series of equal divisions, and in order to facilitate the reading every fifth and tenth mark is longer than the

others. Such divisions fixed in the focus of the eyepiece are seen across the field of the microscope, in such a manner as to see contemporaneously and with the greatest fineness and distinctness the object which it is wished to measure, and the divisions. Let us suppose that the object has transverse lines, of which we wish to know the intervals, in order to deduce what number would be required to occupy the space of a millimètre. To obtain this I arrange the object under the eyepiece micrometer, in such a manner that the striæ may be parallel to the divisions of the micrometer, and by causing one of the divisions to be superimposed, and to coincide with one of the striæ, I determine how many of them there are in the space of one or more of the divisions, taking notice that the observation will be the nearer to the truth in proportion as it extends over a greater number of divisions. Knowing the value of the ocular divisions in relation to the magnifying power used, with a very simple equation we obtain the number of the striæ in the object corresponding to one millimètre.

Thus, for example, I take for observation a Diatom in the shape of a boat, in which the central nodule is seen to be dilated transversely, and I recognize it as a *Stauroneis Phœnicenteron* (Ehrbg). The valves of this Diatom are ornamented with very fine moniliform striæ, and rows of granules. I wish to know their thickness or the number of them which correspond to a millimètre. For that purpose: 1st,—I adapt to the microscope a micrometer eyepiece: 2nd,—I cause the division to be superimposed on the lines of the *Stauroneis*, exactly combining one of them with one of the divisions: 3rd,—I count the striæ comprised between five divisions of the micrometer, and find they are exactly eight. I ought now to ascertain the value of a unit in the division of the eyepiece, and I obtain it by substituting for the preparation placed under the microscope an objective micrometer, that is to say, a millimètre divided into a hundred parts, and cut on a thin glass; and recognizing that in the magnifying power used forty-nine divisions of the eyepiece correspond to six hundredths of a millimètre; I establish the proportion : $49 : 0.66^{\text{mm}} :: 1 : x$. Thence $x = \frac{0.66^{\text{mm}}}{49} = 0.001224^{\text{mm}}$, which is the value of a unit in our case. Now, since eight was the number of the striæ which were counted in five units of the ocular micrometer, we ought to say: if in $5 \times 0.001224^{\text{mm}}$ there are eight striæ, how many are there in one

millimètre? And the final result will be $\frac{8}{0.00612\,\mathrm{mm}}=1307$. Whence the striæ of the *Stauroneis Phœnicenteron* are of such fineness that 1307 of them are contained in a millimètre.

Although such a method of taking small measures may be correct in theory, and in most cases is found the most practical, yet in many circumstances of recognizing the finest details it becomes a difficult and uncertain method. And this is specially the case when one has to do with the most difficult Diatomaceæ, the study of which requires the most powerful objectives, and the most accurate direction of the illumination. Anyone who has familiarised himself with the study of these can well bear me witness how the perception of very fine striæ requires a sustained tension of the visual faculty, so that one frequently hesitates, and it is not always possible to recognize without hesitation and with certainty the number of very minute striæ which may be confined in an interval which, relatively to the magnifying power used, and to the infinite smallness of the details, appears considerable. Such an inconvenience I have been able partly to obviate by the use of variable eyepiece micrometers. I have two of these, one with cobweb lines, constructed by Nachet, of Paris, the other with variable points by Hartnack; the two lines or threads of the first and the two points of the second are separated from each other to a given distance, which is determined in the first place by comparison with an objective micrometer. The Diatom being placed in the middle of the field of vision under the variable micrometer, the number of striæ is determined, either at one glance or by very slowly advancing one of the lines or one of the points, and fixing all the attention on the point or line in motion, and on the crossing made successively by the striæ, from which it is possible to determine the number.

But still, this method presents a grave difficulty in the oscillation which is inevitably communicated to the instruments, so that more striæ seem to pass before or behind the moveable point, so that here again I find myself in uncertainty and in the fear of erring. Such difficulties cannot be overcome otherwise than by rendering the eyepiece micrometer independent of the body of the microscope, by fitting to it a supporting foot distinct from the mounting in question. In the absence of such an arrangement, when I am about to occupy myself with the Diatomaceæ, which are most difficult, on account of the extreme delicacy of the stria-

tion with which they are adorned, I usually approach the two points of Hartnack's micrometer very close, so as to be able to include in the interval only one or two striæ which I judge I can easily keep within view. Afterwards I substitute for the microscopic preparation, in the plane of the object-holder, the objective micrometer, with the micrometer cut on the glass, with the Camera Lucida; I draw the interval between the two points, and that of a hundredth of a millimètre magnified in the microscope, and by observing the number of times that the latter is greater than the former, and multiplying it by the number of striæ observed between the two points, I obtain the number of striæ contained in one hundredth of a millimètre, and consequently the number contained in a millimètre.

All these systems certainly give an approximative idea of the measures, but we cannot expect from them an exact and precise determination, and this so much the more in proportion as the basis of the calculation may be smaller;—seeing that any error there may be in the first place, though only of a fraction of a stria by being multiplied as many times as the smallest space is comprised in the measure of the millimètre magnified in the microscope, may amount to a sufficiently notable difference from the trnth. And this I think may be the origin of the differences in the number of the striæ which are observed in the Diatomaceæ of the most distinguished micrographers, who purposely and specially, or only accidentally, have occupied themselves with the Diatomaceæ, in order to the determination of the species to which they belong. Having, however, proposed to occupy myself principally with the study of this interesting class of organisms, I was led to think of some method which, by facilitating the operation, would lead me to a more exact estimation, rendering it not only possible, but relatively easy, to count the striæ, and in consequence determine their sizes and that of their intervals.

Such a method I find in the habitual use of Photo-Micrography, by which means I reproduce the different forms which present themselves in my researches. Having proposed to myself to edit a most complete photographic monograph of the whole order of the Diatomaceæ, in which I have up to the present time included nearly a thousand types, I adopted the magnifying power of 535 diameters for the reproduction of these, so that I could keep an approximative account of the relation of size between one type and

another. The images which I obtain directly, and which are usually called by photographers, negatives, from which I print off so many identical proofs, are obtained on plates of glass. These present with the greatest fineness and fidelity, not only the form of the Diatomaceæ, but even the finest details, which can only be perceived with doubt and great trouble when observing them directly under the microscope. Would that we could obtain equally fine results in the positive which is printed on paper, and which, by the imperfection of the surface presenting small asperities of elevated and depressed points, does not perfectly and equally adhere to the glass of the negative, and is far from presenting the same degree of fineness! Having thus at my disposition the most faithful and authentic representation of the Diatomaceæ on a plate of glass, I direct my attention to this, and on it I follow the enumeration of the striæ. To facilitate the enumeration I count the lines which correspond to a hundredth of a milimètre, multiplied five hundred and thirty-five times, and I see how many lines are included in a space of the negative equal to 5.35^{mm}. This measure, cut on a thin metallic plate and placed on the negative or matrix, gives the greatest facility for obtaining the number which, multiplied by a hundred, will give as the final result, the precise number of striæ, or rows of dots, which cover the valves of the Diatomaceæ.

Those, however, who are not able to have recourse to Photo-Micrography, which also offers the incalculable advantage of giving as it were, an authentic reproduction of the objects under study, in order to be as near as possible to the truth, ought to have recourse to repeated measurements according to different methods, assuming for the final result, the mean number obtained by the repeated operations.

Translated from the Italian, Nov. 16th, 1869.

NEW BOOK.

The Anatomy and Physiology of the Blow-Fly (Musca Vomitoria).—A Monograph. By Benjamin Thompson Lowne, M.R.C.S. Eng. Illustrated with ten plates. London: Van Voorst; pp. 121. 8vo.

We have been favoured with a sight of the proof sheets of the above work, which is now nearly ready for issue to the subscribers. We have not time to execute a review which shall do justice to the merits of Mr. Lowne's elaborate monograph, and, in fact, we doubt whether much more could be done than refer to the work itself. A more comprehensive treatise on the microscopic anatomy of a single insect has, probably, never been published, and we sincerely hope that the author's labours will receive their due appreciation. We feel bound to add that this work owes its origin to the Quekett Microscopical Club.

On the Observations necessary for Correcting Object Glasses. By F. H. Wenham.*

For this purpose, a particle of mercury is placed upon a slip of black glass. A piece of watch spring, or the thin handle of a spatula, is held up at its end by the fore-finger of the left hand, and slapped smartly down on the mercury, which is thus beaten into powder in the form of numerous minute globules. Of these, a larger size is selected for correction for colour, and a minute one for ascertaining the errors of figure and centering and state of the oblique pencils.

The globule must be illuminated by direct candle or lamp-light, and not by daylight, as the latter will not allow perfect correction to be obtained. The light requires to be set as close as it can be, and, of course, in the highest powers when there is little distance in front it must be very oblique, but this is of no consequence, as it is not the globule itself, but the spot of light reflected from it that is required to be seen.

The lens to be tested is adapted to the microscope having the ordinary Huyghenian eyepiece. On placing the globule either in or

* Extracted from the *Monthly Microscopical Journal.*

out of focus the luminous point expands into a ring. If the object glass is under-corrected for colour as in a single lens, the bright ring appears within the focus, the outer margin is red, and the inner circle green. If the lens is over-corrected the bright ring appears *without* the focus, with the colours in the same order as before. A practical knowledge only derived from these appearances can determine the amount of concavity to be given to the flint, or difference of convexity in the crown, for obtaining the desired correction; but even in the most experienced hands it generally involves several alterations to secure perfect achromatism. When this is corrected as far as practicable, a pale green colour only is perceptible beyond the focus. This arises from the secondary spectrum or relative difference in the width of the prismatic colour spaces of the crown and flint, and seems to be a variable condition, according to the composition of the glass employed.

Though correction for spherical aberration is intimately related to that of colour, a single lens, when finally achromatised, being also nearly free from spherical error, yet in a combination of three pair, when matched so as to be achromatic, this may be so considerable as to render the object glass useless, and is oftentimes exceedingly troublesome to remedy. The error may arise from an improper proportion between the relative foci of the lenses—as the back being too long. I have before stated that in the form that I have advocated the spherical aberration is mainly corrected by giving thickness to the front lens, and by properly adjusting the distance between them. In a glass spherically under-corrected the light from the globule is greatest within the focus, and when set out of focus, speedily vanishes and becomes diffused; in the case of spherical over-correction the contrary appearances result. When the relative distance of the lenses is rightly adjusted, the light spot expands equally, and is of the same intensity for a short distance on either side of the focus, in which the globule should appear with a clear bright margin. The object-glass is now in a proper condition for testing the errors of construction and workmanship.

To examine the condition of the oblique pencils, and consequent flatness and distinctness throughout the field, a small globule is selected and brought to the edge, using the lowest eyepiece. If the bright point in the centre of the globule, when a little out of focus, approaches to the inner side of the concentric light rings, it

is termed "outward coma," and indicates that the front incident surface of the back triple is too *convex*. If, on the other hand, the bright spot is on the outer side of the rings, or next the margin of the field of view, there is "inward coma," which shows that this same surface is too flat. I have previously remarked that this curve has a powerful effect on the flatness of field, and perfection of the oblique pencils, and for them no other correction is generally requisite than an alteration in this radius.

Before the glasses are finally cemented in their cells, they should be carefully tested for centering; for this purpose a very minute globule is selected and placed exactly in the centre of the field. If the bright spot appears excentric, the pair of lenses which occasion the error should be shifted on each other while warm enough to cause the Canada balsam by which they are cemented together to yield, till on repeated trial the error is corrected. This is important, as the least fault in centering materially impairs the performance of an object-glass.

There is yet one other globule test for object-glasses to indicate accuracy of workmanship, or whether the lenses are worked to true spherical surfaces. If the rings from a minute globule appear of an irregular wavy outline, either approximately to a polygon or a triangle, it shows that one of the surfaces at least that refracts the rays is of this form. Such workmanship is inexcusable, and those that cannot avoid it had better let glass grinding alone.

Finally, there is an appearance that I have sometimes seen in our best object-glasses, when focussed away from a globule, viz., "Newton's rings." This shows that in the contact surfaces of one of the pair of lenses the convex is deeper than the concave, and bears hard in the middle. This may have no worse effect than the loss of light, but still it is as well avoided.

QUEKETT MICROSCOPICAL CLUB.

ORDINARY MEETING.

SEPTEMBER 24TH, 1869.

P. LE NEVE FOSTER, ESQ., PRESIDENT, IN THE CHAIR.

The minutes of the preceding meeting were read and approved.

The following donations were announced :—

"Science Gossip" and "The Monthly Microscopical Journal," from the Publisher; "Land and Water," from the Editor. Curtis's Photographs of the 19th band of Nobert's Test-plates, consisting of three positives and two glass negatives, from the Surgeon-General U.S.A. Army, Washington; four Coloured Drawings of the Transitional Stages of the Privet Hawk Moth, by Cyril B. Harcourt; three Microscopic Preparations of *Trombidium Autumnale*, illustrative of Dr. Wright's paper, from the late Dr. Wright and Miss Webb; "Maxime miranda in minimis," from Mr. Richter; Pamphlet on Reade's Prism, from Mr. Highley; one slide of the Harvest Bug, from Mr. Curties.

The thanks of the Club were returned to the donors.

The Secretary read a paper, by the late Dr. J. J. Wright, "on the Harvest Bug."

A short discussion ensued.

Mr. Wright described a method whereby Reade's prism might be used as a polariscope by attaching a bundle of thin glass plates to one face of it.

The Secretary described a new form of microscope for aquarium observation, invented by Mr. J.W. Stevenson.

Votes of thanks were accorded for the various papers read.

The President announced that the subscription list to the Bywater testimonial would be closed on the 30th instant.

The names of five gentlemen proposed at the last meeting were ballotted for, and declared duly elected.

The Secretary announced that the following objects among others were about to be exhibited :—*Fredericella sultana*, by Mr. Golding; *Ballia callitricha*, by Mr. Wright; *Pleurosigma balticum*, with Reade's prism, by Mr. Suffolk; three beautifully coloured drawings of the House Fly and Spider, by Mr. Richter.

The Secretary announced that Mr. Suffolk's course of lectures was being published in the "Chemical News."

Dr. Braithwaite announced that he was about to deliver a course of lectures on Bryology, to members of the Club, at his house, on the second and fourth Thursdays in each month, commencing in October. Those who wished to attend were requested to send in their names at once.

Mr. Suffolk expressed his willingness to repeat his course of lectures at the commencement of the ensuing year, should a sufficient number of members present themselves to form a class.

The names of the following gentlemen were proposed for membership:—Mr. C. J. Fox, Mr. Cyril B. Harcourt, Mr. Henry Davis, Mr. J. D. Rendell, and Mr. W. F. Shore.

A paper by Mr. Lowne was announced for the next meeting, as also the excursion for the ensuing month, and the proceedings terminated in the usual manner.

ORDINARY MEETING.

OCTOBER 22ND, 1869.

P. LE NEVE FOSTER, ESQ., PRESIDENT, IN THE CHAIR,

The minutes of the preceding meeting were read and approved.

The following donations were announced:—"Science Gossip" and "The Monthly Microscopical Journal," from the Publisher; "Land and Water," from the Editor; Huxley's "Introduction to the Classification of Animals," from Mr. Arnold; fifty slides from Mr. M. C. Cooke; two slides from Mr. Curties; one slide from Mr. Tatem.

The thanks of the members were returned to the respective donors.

Five gentlemen proposed at the previous meeting were then ballotted for, and declared duly elected.

Mr. B. T. Lowne read a paper "On the Aid Derivable from the Microscope in the Classification of Animals."

Dr. Braithwaite made a few remarks on the remarkable character of Mr. Lowne's paper, and expressed his conviction that the investigation of the subject could not be in better hands.

Mr. Hailes read a paper "On some Portions of Skin supposed to be Human, found on a door in Westminster Abbey."

Thanks were voted for the papers read.

A number of objects were announced for exhibition.

The following gentlemen were proposed for membership:—Messrs. E. M. Chater, Ed. Hart, Edmund Perken, and George Naylor Stoker, F.R.M.S.

The Secretary called attention to the extra meetings, and expressed his conviction they formed a characteristic distinction of the Club.

The proceedings terminated in the usual manner.

ORDINARY MEETING.

NOVEMBER 26TH, 1869.

P. LE NEVE FOSTER, ESQ., PRESIDENT, IN THE CHAIR.

The minutes of the preceding meeting were read and approved.

The following donations to the Club were announced:—"The Chemical News," from the Publisher and Mr. Suffolk; "Science Gossip" and "The Monthly Microscopical Journal," from the Publisher; "Nature," from the Publisher; "Taylor's Scientific Calendar for 1870," from the Publishers; twelve slides from Mr. Curties; six slides from the Secretary; "Land and Water," from the Editor; specimens of Sponge Sand, from Mr. Lemon.

Thanks were voted to the donors.

Mr. Durham described a microscope designed by Mr. Marshall, President of the Birmingham Natural History Society, and made by Mr. Field. It was contained in a case which comprised a simple microscope with five or six powers, with a cell for dissecting and pins for setting out an object. The dissecting stage being removed, a mounting plate was put in its place with a contrivance for centering and a turntable. The case also contained a tray, with mounting materials and slides, and a drawer with dissecting implements. A tube or body could be attached, so as to convert the instrument into a compound microscope with a good achromatic combination, and also other apparatus; the price of the whole being £3 10s.

Mr. Durham also read a letter from Mr. Tomlinson, calling the attention of members to the motions of particles of Camphor. It was said that small fragments of camphor would rotate if placed on any smooth, clean, solid surface, and that the motion might be seen under the microscope; members were invited to repeat the experiment, and communicate the results to Prof. Tomlinson for publication.

The President announced that the four gentlemen proposed at the last meeting had been ballotted for, and elected members of the Club.

Mr. Hislop read a description of a new simple Selenite Stage.

Mr. M. C. Cooke read the translation of a paper by Count A. F. Castracane, "On Micrometric Measurement."

Dr. Matthews pointed out that in measuring by the aid of the Camera Lucida, the amount of light diminishes as the object is enlarged, and that a different calculation is required for each eyepiece and objective used. As to diatom markings, they were variable even in different parts of the same valve; with cobwebs also it was difficult to say where to begin the measurement.

Mr. Lowne had made all his measurements with the Camera Lucida, making a scale from the stage micrometer, and always using the same objectives and eyepieces, and the same distances from the paper. There were, however, one or two little points which required some attention, and which every novice finds a matter of extreme difficulty, because he does not get a due balance of light between the object and the paper. By using a reflected light from the plane mirror for the object, and a direct light from a lamp for the paper, adjusted according to the requirements of the object, there would be no trouble in the matter. For all rough measurements it was far the best method, though for diatoms it might be necessary to use something more delicate, but no difficulty would be experienced in camera lucida measurements down to 100 diameters.

Mr. Breese had found that the ordinary Beale's neutral tint reflector, with a micrometer on the stage, would give measurements as approximate as were required for all ordinary purposes. The method proposed by Dr. Matthews would give as good results as anything, with fine measurements, provided that one of the points were moved by a tangent screw.

Dr. Matthews said that he had mentioned in his paper that the handles of his micrometer might be worked by tangent screws; these had since been added, and leave nothing to be desired. In using high powers it is a matter of great importance to have perfect steadiness, and when a tangent screw is used the motion is as delicate as could be wished; it was not necessary to have a tangent screw to both points. He should be happy to show the instrument again with this improvement added.

The Secretary read an extract from "The Photographic News," describing the Albertype process, and suggested its applicability to the illustration of books on Microscopy. Specimens of the process were exhibited. The cost of prints, 6in. by 8in. was stated to be sixpence each, which sum was subsequently doubted as being too large.

Mr. Breese pointed out that the specimens exhibited were soft and well adapted to likenesses, but they were without detail, and therefore quite useless for microscopic purposes.

Among other objects exhibited attention was called to *Amphipleura pellucida* (*acus*), shewn by Mr. Powell, with one-eighth Immersion lens.

The following gentlemen were proposed for membership:—Messrs. Henry Jones Coppock, John Salmon, Gilbert Sanders, Benjamin D. Jackson, F.L.S., William Parker, M.D., George Ackland Ames, D. W. Hill, Thomas Lloyd, and Arthur Brewin, F.R.A.S., F.R.M.S.

PRESENTATION OF A TESTIMONIAL TO MR. BYWATER.

The President having vacated the chair, it was taken by

Mr. Arthur E. Durham, who said that on no previous occasion had he occupied that chair with so much pleasure, and he considered that great courtesy had been shewn him in requesting him to do so now. All present knew how the Club had originated, and what a marked and signal success had attended it since its commencement. Amongst those of its first founders, and those who had done most to contribute to its success, no one had been more active than Mr. Bywater, who for the past four years had been its Honorary Secretary; he knew that in discharging the onerous duties of his office no secretary ever did his work in a more indefatigable manner, or with such hearty good will. At length a time came when he found his labours crowned with success, and the Club in such a vigorous condition as to be able to go on without such constant care, and feeling that he might safely lay down his charge, he had resolved to retire from the office he held so long. We felt that we ought to render him some acknowledgment of his services, and it was resolved to present him with some permanent mark of our sense of the value of those services.

A service of plate, consisting of a salver, silver coffee-pot, teapot, cream jug and sugar basin, was then brought forward, and Mr. Bywater was asked to accept it in the name of the Club, Mr. Durham at the same time expressing regret for the loss of his services, and good wishes for the future. The following inscription was engraved on the salver:—

> "Presented, together with a silver tea service, to Witham Matthew Bywater, by members of the Quekett Microscopical Club, as a token of appreciation of his indefatigable exertions both as a founder of the Club and as honorary secretary during four years. 1869."

Mr. Bywater expressed his deep sense of obligation to the members for this valuable mark of their kindly feeling and esteem, and he hoped that he should be pardoned, if his words failed to express all he felt upon the occasion. He looked back with pride to the period during which he had been associated with

the Club, which had been an unparalleled success, and had astonished its most sanguine promoters. When he first undertook the office of Secretary he told those who worked with him that he could lay no claim to scientific knowledge, but would give the work he had to do such attention as was compatible with business. He regarded the past four years with considerable pleasure, for amongst the many new associations into which he had been brought true friendships had been formed among those with whom he had worked, and which he believed would be as lasting, now that his position was altered. He should ever regard with pride the splendid testimonial with which he had been presented, and for which he again thanked them heartily.

The proceedings then terminated with a conversazione.

In reference to the testimonial presented to Mr. Bywater we are requested to add that the list of subscribers comprehended about 150 names, and that the arrangements were carried out by a committee composed of the following gentlemen, viz.:—Messrs. Arnold, M. C. Cooke, Curties, A. E. Durham, Gay, Dr. Gray, Hislop, Ketteringham, Kent, Leighton, McIntyre, W. W. Reeves, Reynolds, and Watson.

The Geographical Distribution of Mosses in Europe, and their Aspects in Nature.

By Robert Braithwaite, M.D., F.L.S., V.P.

(Read 28th January, 1870.)

To the unobservant eye Nature discloses nothing, yet she scatters her productions broadcast over this fair world of ours, and by the massing of individuals, or admixture of species, stamps each locality with its own peculiar features.

Among the plants which take part in this, and to a much greater extent than is generally supposed, are the Mosses, and I have thought that an outline of their geographical distribution in Europe as given by Prof. Schimper, might interest those who do not study them more particularly.

He divides the whole of Europe into three zones.

1st.—A Northern Zone, extending from the Arctic Ocean to the 60th parallel of latitude, and thus including N. Russia and the Scandinavian Peninsula, and at its western end descending to 57° so as to take in the N. of Scotland.

2nd.—A Middle Zone, embracing all the country between the 60th parallel, the German Ocean, and the south foot of the Alps, or a line on the 46th parallel from the outlet of the Danube to the mouth of the Garonne.

3rd.—A Southern Zone, extending south of the last to the Mediterranean and Black Sea.

The Northern Zone presents sufficient diversity of character as to permit of its division into an arctic and a lower part.

In this zone about 480 species are found, but the arctic portion has only some 160; the individuals however occur in such vast numbers as to impress a decided feature on the landscape, the *Polytricha* especially give a gloomy aspect to these desert regions, only relieved by great bogs covered with *Sphagna*, and on the rocks black tufts of *Andreæa* and hoary *Grimmias.*

Yet it is here that some of the rarest species reward the Bryologist, and it is in such solitudes as even our own country can

offer in the wild mountains of Braemar and Glen Lyon, that we indeed feel alone with Nature, and with Nature's God.

The lively green of more temperate climes is nowhere visible among the far-and-wide spreading mosses of the Arctic Northern Zone, yet among them are found scattered some species which even excel in beauty those of the most favoured countries, witness these *Splachna luteum* and *rubrum*, which do not descend to the most northern point of Britain, yet form a striking object in the bogs of Lapland and N. Russia. As we proceed southward, new species are added to the list, the trees lose their lichens, and often support mosses, though the Sphagnum swamps are still a noticeable feature. Besides the *Splachna* mentioned, we have also *S. Wormskioldii* and *vasculosum*, the latter reaching the Scotch mountains, with *Œdipodium*, *Psilopilum arcticum*, a number of Hypnaceæ and Bryaceæ, and various species of *Andreæa* and *Dicranum* which are confined to the northern zone.

The Middle Zone, embracing the greatest extent of country and the most varied surface, is also the richest in species, many of which pass over the northern and southern boundaries into the corresponding zones. Six hundred species of mosses have been enumerated in this zone, and some are characteristic of it, as several of the Phascoid group, *Anœctangium Hornschuchianum* and *Sendtnerianum*, *Braunia sciuroides*, *Tetrodontium repandum*, *Encalypta longicolla* and *apophysata*, &c.

The Southern Zone having a more elevated temperature, and wanting the dense forests of central Europe, is less adapted to the growth of mosses, and the list falls to 340 species; yet the slopes of the Pyrenees and Apennines have a rich bryological flora, and some species are peculiar to the Mediterranean area as *Phascum Carniolicum*, *Bruchia Trobasiana*, *Fabronia*, *Fissidens grandifrons*, *rivularis*, and *Sardous*, and especially a number of Trichostomaceæ, some of which, encouraged by the higher temperature of the coast, creep up the Atlantic shore of France, and extend over to the south of Ireland and south-west of England, and thus become rarities in the British Flora; of these I may mention *Tortula squarrosa*, *Vahliana* and *cuneifolia*, *Trichostomum flavo-virens*, *crispulum* and *brachydontium*, with *Bryum Tozeri*, *torquescens* and *Donianum*, *Leptodon Smithii*, *Daltonia splachnoides* and *Hookeria lætevirens*.

For a similar reason the coast of Norway, and its parallel

mountain range, the Dovrefjeld, are rich in mosses, being exposed to the influence of the Gulf-stream, which greatly modifies the severity of the climate. Besides this superficial distribution, another still more important is that in altitude, or range above the sea level, and this is marked out by lines gradually descending as we pass from south to north, until in the Arctic Zone they become closely approximated; in fact, the lines form arches from pole to pole, whose highest point or crown is over the equator.

Prof. Schimper indicates five regions for the distribution of mosses altitudinally, all of which are characterised by certain predominant species, just as they are by certain flowering plants, and we have only to climb any elevated mountain range to find that the plants we first met with disappear as we ascend, and are replaced by other species, which also have their limits, until we reach the line of perpetual snow, beyond which all is solitude and desolation, and the crustaceous lichens even fail to maintain a footing.

Commencing at the sea level we have:

1st.—The Campestral Region, or that of the cereal plants and fruit trees, which extends up the mountains to a variable height, according to the latitude; thus in the Southern Zone, on the Pyrenees, it reaches to 3100ft. on the south side and 2100ft. on the north; in the Middle Zone it approaches 1400 in the southern parts, falling to 750 and 500 at its northern limit; in the Northern Zone it descends so rapidly from 500 to 0 that at 66° it disappears, and thus in the Arctic part of this zone the campestral region is altogether wanting.

You will observe that this region in the separate zones presents very different conditions of surface: we have the artificial substratum of cultivated fields and roadsides, hills and woods, open desert plains, heaths, bogs, and marshes, and all varying *inter se*, according to the nature of the soil, whether calcareous or argillaceous, sandy, rocky, or stony; and according to this difference in the chemical constituents of the soil are certain species predominant, and hence the aspects of the campestral region are in the highest degree varied. Many mosses of this region extend upward to the one above, from which again others descend into it. It would be tedious to enumerate the species occurring in this region, since they comprise all that are generally diffused over our downs and heaths, woodland banks, and hills of moderate elevation.

2nd.—The Montane Region ascends from the cultivated region to

the upper limit of growth of the beech, and extends in the southern zone from an altitude of 5800 to 6800ft., in the middle zone from 1400 to 3400, and in the arctic northern descends into the plain but little above the sea level. The features of surface are dense woods of oak, beech, and pine, stony banks of streams and rocks, all localities congenial to a rich growth of mosses.

The most characteristic species are—*Bryum crudum*, *elongatum* and *Duvalii*, *Cinclidium Stygium*, *Amphoridium Mougeotii*, *Tetraphidaceæ*, *Bartramiaceæ*, many *Polytricha*, *Dicranaceæ* and *Grimmiaceæ*, *Ulota Drummondii*, *Ludwigii*, *crispa* and other Orthotrichaceæ, *Hypnum Halleri*, *crista-castrense*, *commutatum*, *uncinatum* and *revolvens*.

3.—The Subalpine Region reaches from the limit of the beech to the upper limit of the *Pinus abies*, or spruce fir; the beech, when it does occur, has ceased to be a tree, and takes the form of a shrub. The chief features are pine and birch woods, rocky streams, bare mountain pastures, turf bogs and rocks. The rapid streams bring down many mosses from the higher region, which become associated with others of the region below.

In the northern zone the most characteristic mosses are—*Andreæa rupestris*, *petrophila* and *falcata*, *Blindia acuta*, *Ditrichum flexicaule* and *homomallum*, *Distichium capillaceum*, *Grimmia apocarpa* and *patens*, *Splachnum* sp., *Mnium cinclidioides* and *spinosum*, *Timmia*. *Bartramia ithyphylla* and *Halleri*, *Oligotrichum*, *Pogonatum alpinum*, *Polytrichum gracile*, *Pterogonium filiforme*, with *Plagiothecium pulchellum* and *Muhlenbeckii*.

4.—The Alpine Region extends above the upper limit of the fir, and commences with the *Pinus Pumilio*, or dwarf pine, ending where that ceases to grow.

In the northern zone the birch tree has disappeared, but the *Betula nana*, or dwarf birch, as an erect shrub, occupies marshy ground, and *Salix Myrsinites*, *Menziesia cærulea*, *Silene acaulis*, *Diapensia Lapponica*, &c., flourish abundantly. Many fine mosses now appear for the first time, and yield a rich harvest to the collector, as any who have explored the Highland mountains must have observed.

Among our British species I may enumerate *Dicranella Grevilleana* and *subulata*, *Dicranum falcatum*, *Blyttii*, *glaciale*, &c., *Distichium*, *Rhabdoweisia*, *Grimmia* many sp., *Dissodon*, *Tetraplodon*, *Bryum julaceum*, *Muhlenbeckii*, *polymorphum*, &c., *Tortula Drum-*

mondii, Ditrichum glaucescens, Polytrichum sexangulare, Amphoridium Lapponicum, Encalypta commutata and *rhabdocarpa, Andreæa crassinervia, petrophila, alpestris* and *obovata, Hypnum sarmentosum, callichroum, Bambergeri, sulcatum,* &c., *Myurella julacea* and *apiculata.*

5.—The Supra-Alpine Region, reaching above the limit of *Pinus Pumilio* and *Betula nana* to the line of perpetual snow.

Here we have vast sterile rocks, some beaten and lashed by every tempest, others constantly irrigated by streams from the melting glaciers, with patches of short grass and deposits of black earth, often mixed with detritus from the rocks above. In the middle zone this region lies between 6,800 and 8,300 ft., in the northern from 4,800 it descends gradually to below 2,800. Although the line of perpetual snow does not touch our Scotch mountains, we have snow fields more or less extensive lasting through the summer, as on Ben Nevis and the Cairngorm range, and we have some of the characteristic mosses of this region, as *Conostomum, Bryum demissum, acuminatum, Ludwigii,* and *polymorphum, Pottia latifolia, Dicranum fulvellum, Grimmia Doniana, contorta, elongata* and *montana, Polytrichum sexangulare, Andreæa nivalis, alpestris* and *obovata, Hyp. glaciale, uncinatum, sarmentosum, arcticum,* &c.

I may now say a few words on the various habitats affected by mosses, some of which, no doubt, have come under your notice, if only as the little *Tortula muralis*, which raises its fruit stalks in serried ranks between the bricks of our garden walls, or the *Bryum argenteum* and *Ceratodon purpureus* that overrun neglected paths. These, however, are sufficient to teach you many points in the structure of the class to which they belong, and they will show you, also, that mosses are pre-eminently social plants, that they never occur as solitary individuals, but live in densely aggregated colonies, which unite with others of various kinds, and thus form that verdant carpet which, as Prof. Schimper well observes, "animates with brightness the highest mountains, inaccessible to more perfect plants, enlivens woods impervious to the sun's rays, and protects the earth against the drying and congelation equally fatal to vegetable and animal life." A very little observation will tell us that certain habitats have their constant occupants, and thus an old wall becomes a very botanic garden to the Bryologist. Such we may term mural species, and foremost among them place the never failing *Tortula muralis*, and its pretty constant companion,

Grimmia pulvinata, associated with which are *Tortula revoluta*, *Bryum cæspiticium*, *argenteum*, and *capillare*, *Hypnum sericeum polymorphum*, *tenellum*, *murale*, &c. Roofs of outhouses, both of thatch and wood, support *Tortula ruralis*, *Didymodon flexuosus*, *Ceratodon*, *Weisia cirrhata*, &c.

Passing next to the road sides and cultivated fields, we find on clay soil Ephemerum, and most Phasca, *Pottia truncata* and *minutula*, with *Tortula ambigua*, *unguiculata*, and *fallax*, *Physcomitrium pyriforme* and *Weisia controversa;* on waste ground and gravelly commons Funaria, Ceratodon, and *Bryum argenteum*, and where these are heathy *Polytrichum piliferum*, *Pogonatum aloides* and *nanum* and *Dicranella heteromalla.*

From the mural mosses it is but a step to the saxicolous, or rock inhabitants, for some species are common to both; they vary however, according to the chemical constituents of the rocks, and according to the altitude of the locality. Thus we have the silicicolous, or those living on siliceous rocks, of which there are two types, sandstone and granite, both widely distributed.

Sandstone rocks are a favourite site for many species, the porous nature of its particles permitting water to percolate freely, and allowing them easily to fix their roots. *Schistostega*, *Seligeria pusilla*, *Tetrodontium*, *Amphoridium Mougeotii*, *Thamnium alopecurum*, *Grimmia apocarpa*, *Amblystegium filicinum* and *commutatum*, are seldom absent from them.

Granite, on the other hand, is more compact, yet often contains those ledges and fissures in which so many alpine species delight to establish themselves, numbering among them all the Andreæas, *Cynodontium polycarpum* and *Virens*, *Dicranum Scottianum*, *longifolium* and *hyperboreum*, *Grimmia*, many sp., *Hedwigia*, *Racomitrium*, *Ptychomitrium*, *Glyphomitrium*, *Orthotrichum rupestre*, *Sturmii* and *Hutchinsiæ*, *Brachyodus*, *Campylostelium*, *Anodus*, *Mielichhoferia*, *Bryum alpinum*, *Muhlenbeckii* and *julaceum*, *Hyp. molle*, *umbratum*, *demissum* and *Starkii.*

Calcicolous mosses, or those of chalk and limestone, are often peculiar to that formation, such *e.g.* as *Eucladium*, *Seligeria* several sp., *Weisia calcarea* and *rupestris*, *Trichostomum tophaceum* and *flexicaule*, *Grimmia anodon* and *orbicularis*, *Encalypta streptocarpa*, *Bartramia Œderi* and *calcarea*, *Hypnum tenellum*, &c.

Another group which adds much to the enjoyment of sylvan scenery, is the arboricolous, or those residing on living trees—the

beech, willow, and larch bearing the greatest number of tenants, among which the species of *Orthotrichum* hold the first place, sôme, indeed, being confined to a single kind of tree. We have also *Cryphæa, Leucodon, Zygodon,* several sp., *Tortula lævipila* and *latifolia, Leskea pulvinata, Habrodon Notarisii, Neckera* sp., with many others.

The lower part of the trunks and stocks are also often coated with a beautiful mat composed of creeping interwoven stems, the most frequent being *Stereodon cupressiformis, Amblystegium serpens* and *Anomodon viticulosus.*

The only other group impressing a marked feature on the locality it occupies is the Paludal, comprising the species living in bogs and marshes, foremost among which are the Sphagnaceæ, which in northern regions cover vast areas with their pale green masses. Besides these, we have also *Polytrichum commune, Aulacomnium palustre, Meesia, Mnium punctatum, subglobosum* and *cinclidioides, Hyp. fluitans,* and others of the *aduncum* group, with *cuspidatum, nitens, stramineum* and *cordifolium.*

In illustration of some of these aspects, I place before you sheets of specimens, in some cases with the flowering plants also with which they were associated, the last labour of one now no more,* who thus attempted to work out the idea of representing the flora of each locality at a glance.

In this sphagnum tuft you notice the dense aggregation of individuals, to the exclusion of all other forms, which, with its loose cellular texture, give it that spongy character so treacherous to all who venture on it.

Here are sheets from the Gap of Dunloe, with the wild *Saxifraga umbrosa,* or London Pride, and from Killarney, rich with *Hookeria lœtevirens,* and *Hymenophyllum,* associated with the fine Hepaticæ, *Hygrophila irrigua, Physiotium cochleariforme* and *Trichocolea tomentella.*

Others exhibit the mosses and lichens from sandstone rocks in Eridge Park, and these beautiful specimens from our friend Mrs. C. F. White, are products of the commons about Virginia Water. The Alpine species are represented by collections from Ben Voirlich and Ben Lawers, the latter one of our richest localities.

But especially I would call your attention to the universal asso-

* N. B. Ward, Esq.

ciation of mosses with ferns, for both delight in moisture and shade. Here is a great tuft of *Hypnum loreum* from the surface of a rock at Ambleside, and growing from its centre is the beautiful fern *Polypodium Phegopteris;* the moss, no doubt, was the first occupant, and as it stretched out its tiny arms and thousand little leaves, these detained the dust grains borne onward by the winds, and entangling the autumn leaves, soon converted them into rich mould; anon the fern spore, too, is arrested in its course, vegetates and permeates the tuft with its rhizomes, binding the whole firmly together, and to its rocky bed.

Since mosses require but a point on which to fix themselves, and moisture to continue their existence, no class of plants enjoys such a wide-spread distribution, for from the eternal snows of the highest mountains to the ocean fringe of the shore, they are everywhere prevalent; clasping in their slender, yet tenacious arms the crumbling stone, or hiding, as with a mantle of youth, the prostrate monarch of the forest in his final stage of dissolution, and supplying the last wreath placed by nature on the tomb of man.

How extensive, then, is the field occupied by these plants in the economy of creation! How eminently are they calculated to delight the eye, both by their exquisite structure and the part they play in the scenery of the world around us! Even here, though dead, they may point our moral and adorn our tale, and they will live for ever on painter's canvass and in poet's verse.

Testimonial to Dr. R. Braithwaite.—On Thursday evening, February 10th, a deputation from the gentlemen who had attended Dr. Braithwaite's Lectures on Mosses assembled at his residence for the purpose of presenting him with a token of their esteem and regard. The Testimonial consisted of a Silver-mounted Claret Jug, and Prof. de Notaris' great work "Epilogo della Briologia Italiana." The former bore Dr. Braithwaite's crest, and the latter the inscription, "Presented with a Claret Jug to R. Braithwaite, M.D., F.L.S., in token of the pleasure and instruction derived from a Course of Lectures on Mosses." This was signed by all the subscribers. Mr. Bell, F.C.S., in making the presentation eulogized the care bestowed in the preparation of the Lectures, the clearness of their delivery, and also the hearty friendliness with which the subscribers had been received by Dr. and Mrs. Braithwaite.

Dr. Braithwaite expressed his gratification at the kindly feeling displayed towards him by the subscribers, and at the reception of so unexpected a recognition of his humble efforts to spread a knowledge of his favourite study.

Notes on some French Diatomaceæ, Presented to the Club by Alph. de Brebisson, Corr. Mem.

(Communicated February 25th, 1870.)

Pleurosigma Æstuarii. W. Sm.— Mortalines, near St. Vaast (Manche). In these two preparations there will also be remarked the *Amphora membranacea*, *Nitzschia spathulata*, and even a few individuals of *Toxonidea falcata* and *insignis.*

Pleurosigma gracilentum Rabenh. *P. Kützingii* Grun. This ought to be the *P. Spencerii* of W. Smith's Synopsis, but it is not Bailey's species, according to his own examination.

Navicula (*Pinnularia*) *dactylus.* Ehrb. One of the principal forms of the group which includes the *Navicula* or *Pinnularia nobilis*, *major*, etc., which, doubtless, all have the same origin, as coming from the *N. viridis* Ehrb. (Infus. vol. xiii., f. xvi.)

Navicula punctata (W. Arnott, in litt.) This species, which is always mixed with many other Diatomaceæ, is easy to distinguish by the three enlargements, one of which is central, and two terminal, all rounded, and nearly of the same volume, and especially by its carapace covered with punctuations or rugosities, which appear to be internal. It is this species to which I had in 1828 (" Consid. sur les Diatom. p. 19) given the name of *Frustulia acrosphæria*, but it is not the *Navicula acrosphæria* of Kützing (Bacill., p. 97, tab. 5, f. ii.), the summits of which are not sensibly enlarged, nor, as some authors have thought, the *Nav. tabellaria* of Ehrenberg, which has no punctuations. To avoid a confusion, which is always to be regretted, Walker-Arnott proposed to give to this species the name of *Navicula* (or *Pinnularia*) *punctata*, an opinion which I hastened to adopt, supported by so competent an authority.

Navicula humerosa Bréb. (in W. Sm. App.) This species, which I first found at Divas, in the sandy pools of the sea shore, is pretty common between Trouville and Honfleur in the pools or pits of slightly brackish water with stony bottom.

It much resembles the *Nav. granulata*, but the valves of the latter are more elongated, less suddenly attenuated at the summit, often

contracted towards the middle, and charged with more pronounced and more distinctly moniliform striæ.

Navicula oculata Bréb. (in Desm. Crypt., 110) First discovered by the learned algologist, M. G. Thuret, near Lagny, in the environs of Paris; this species has since been collected by us near Falaise. It is very small, linear, with rounded summits, and remarkable by its very apparent central nodule.

Peronia erinacea Bréb. and W. Arn (in Journ. Micr. Sc.) Different characteristics, and principally the absence of a central nodule on the valves, not permitting this Diatom to be retained in the genus *Gomphonema*, where I had first placed it (see Kützing, Sp. Alg. p. c g, sub. *Gomph. Fibula*) have determined W. Arnott and myself to propose this new genus which at present contains but one single species which grows in fresh water springs, on inundated plants, and especially on the leaves of *Sphagnum*.

Cymatopleura apiculata W. Sm. et var. We do not think that this *Cymatopleura* can be anything but a variety of *C. Solea*. All the forms presented by this species pass so much from one to the other in an insensible manner that it would be always difficult to assign them a place in a regular series. The forms included in the accompanying preparation are the var. *apiculata* and another larger, broader, figured by Ehrenberg in his large work on the Infusoria (t. xiii., xxii., f. 1 and 3) and which, for this reason, I call var. *Ehrenbergii*. Fig. 2 of the same plate must be the variety *Librile*.

Surirella Capronii. I am indebted to Mr. Fr. Kitton for the knowledge of this remarkable *Diatom*. Having communicated to him, nearly two years ago, the mixture of *Surirella* which had been collected in our neighbourhood, he observed to me that, in the midst of the numerous individuals of *Sur. elegans* which were most prevalent, there was another form, the valves of which were provided on their broadest summit with a sort of spur, or salient point, and informed me at the same time that a similar form had been noticed in England by Dr. Capron, the naturalist, who is so often mentioned by W. Smith as having communicated to him interesting researches in the neighbourhood of Guildford. Dr. Capron having been so good as to address to me a preparation of his curious *Surirella*, I was able to convince myself of its identity with the Normandy plant; I then proposed to dedicate it to Dr. Capron. I have since received from the clever Danish preparer, M. Möller of

Wedel, another Surirella, the *S. nobilis* or *robusta*, the valves of which are also armed with a spur. It is the *S. splendida* (?) var. *aculeata* of M. Grunow. Then, finally, I found again near Falaise, a real *S. splendida*, Ehrenb., on the valves of which is also seen a rudimentary spur. This appendage is not, therefore, an essential characteristic, on which we can establish a distinction of species, but only an accidental state, the result of a superabundance of silex in a certain point of the carapace of these Diatoms. Often in such a case, a collection of the siliceous matter, the secretion of which forms the envelope of the Diatomaceæ shows itself on the middle of the valves, in the form of a kind of cord, or medial nerve. This line, strengthened, may remain straight and salient, in consequence of rupture in the point where the valve bends suddenly, especially at the broad and rounded extremity of the cuneiform frustules; at the other summit, which is narrower and less curved inwards, it is rarer to meet with such a spine-shaped appendage, although this anomaly is sometimes met with there.

The *Surirella biseriata*, which is also in these preparations, having no decided curve at the summits of its valves is never furnished with spurs. Nevertheless, this Diatom, although its envelope is not cuneiform, is probably, like the preceding, only a modification of one and the same type.

Surirella linearis, W. Sm. and *Sur. amphioxys*, W. Sm. In examining the different forms which are found mingled together in these preparations, we might be tempted to believe that the drawings given by W. Smith were made from a similar collection. Several authors, and W. Smith himself, have remarked that the figures 58a, a¹ and b¹ of the synopsis (t. 1., pl. viii.) belonged to at least two species. In these preparations may be recognised individuals which ought to be referred to the *Sur. pinnata*, the *S. panduriformis*, and even to the *S. angusta*, which would assign to all these forms one and the same point of departure, an hypothesis which is very admissable.

Surirella crumena Bréb. (in litt. ad Kütz., 1844, con. spec.) *Cyclotella Meneghiniana β. major* Spec. Alg. p. 19. *Surir. Brightwellii*, W. Smith, syn. i., p. 33, pl. ix., f. 69.(?) Fresh and brackish waters, Calvados, Geneva, Montpellier, etc. Misled by a form of *Sur. subsalsa* with large valves and rounded, which I refer to fig. 69, pl. ix., of W. Smith's Synopsis, I thought that as this figure represented the type of *S. Brightwellii* this species ought to be

different from my *S. crumena*; thence came the observation I addressed to W. Smith, which determined him to announce in a note to his 2nd vol., p. 89, that I had recognised characteristic differences between *S. crumena* and *S. Brightwellii.* Since then I have had numerous specimens from England, from W. Smith himself, from W. Arnott, and M. G. Norman, which have convinced me that it was one and the same species. Only it is possible that W. Smith's figure, quoted above, ought to be referred to a form with large and rounded valves of *S. subsalsa.* This latter species is especially distinguished by its inferior summit of the valves, which is attenuated and considerably hollowed into a gutter, and by the presence of applied wings, but these are raised and more apparent near the summits. The valves are also generally oval, while in the *crumena* they are nearly always circular, and so much so that Kützing in his Spec. Alg., p. 19, thought proper to unite this species to his *Cyclotella Meneghiniana* as variety *β. major*; a connection which it is difficult to understand, if we remark the double direction of the *canaliculi* which converge towards two diametrically opposite points of the circumference, the two summits (*Poli* Rab.) instead of radiating regularly in the direction of one centre, as is the case in the *Cyclotella.*

Surirella minuta Bréb. (in Kütz. Spec. Alg.) although this Diatom is always smaller than the *ovata*, that its colour is darker, more blackish, and that its figure is different, it is very probable that it is only a form of *S. ovata* to which ought to be united also a certain number of pretended species which are common in brackish waters.

Nitzschia Brébissonii W. Sm. syn. i., p. 38 (exclus. synonym). I had no right to the honour of this dedication, which must be accepted in order to avoid rendering the synonymy inextricable. This species, from brackish waters, differs completely from *Sigmatella Brébissonii* of Kützing, which inhabits fresh water, and is only a broad and but slightly sinuous variety of *Nitz. sigmoidea*, a variety which may be called *Armoricana* in order to avoid a source of errors. It was the *Synedra Armoricana* of Kützing (Bacill, tab. 4, f. 34.)

Nitzschia obtusa W. Sm. (syn. i., p. 35, pl. xiii, 107.) Pools of brackish water near Trouville. This species is found in abundance in the midst of the filaments of algæ which carpet the surface of the pools. It was thought that the filaments had originally con-

tained the frustules, which would consequently have belonged to the genius *Homeocladia.* This opinion was the result of an incomplete observation. These felted layers supplied the diatom with an accidental station, but were not a part of their individuality.

Nitzschia gracilenta Grun. in. litt. Found in November, 1868, in pools near Falaise, on a clayey soil.

Fragilaria virescens Ralfs. Remarkable in this state on account of its numerous sporangiferous articles, half as long again as the frustules, which are disposed in series, and present the most varied forms.

Eupodiscus Gregoryanus. Bréb. MSS. Cherbourg. This species is probably *Eup. subtilis* of W. Gregory, (Diat. Clyd., p. 29, tab. iii., f. 5.) but it may be doubted, for the figure indicates a kind of central nodule, and does not mention the series of small protuberances (processes) which are placed near the edge of the valves. It is this species which was first indicated by W. Smith, under the name of *Coscinodiscus concinnus.* It cannot be referred to Ehrenberg's *Coscinodiscus concinnus*, and therefore it seems to me better to give it a new name.

Eupodiscus Roperii Bréb. MSS. *Coscinodiscus ovalis.* Rop. This species, like the preceding, ought to belong to the genus *Eupodiscus.* Its texture is the same, and its valves also bear, near their edge, a row of small protuberances or salient appendices (processes), which have no communication with the centre by means of radiating lines, as in the genus *Aulacodiscus.*

This is certainly Roper's *Coscinodiscus ovalis* (Journ. Micr. Sc., vi., p. 3, f. 4.) In truth, in the figure given (*b.c.*), the intermarginal processes are not indicated, and they may have escaped the draughtsman's observation if he had under his eyes a balsam preparation, as this renders these organs too transparent.

This species, and the preceding, ought to belong to the genus *Cestodiscus*, founded by Greville.—(Trans. of Micro. Soc., N.S., vol., xiii., p. 48.)

Cyclotella rectangula Bréb. (*Cycl. operculata β. rectangula* Kütz. Spec. Alg., p. 19.)—I first collected this Diatom near Lagny, in the environs of Paris, and we have since found it around Falaise. It differs much from *Cyclot. operculata*; its valves are plane and not undulating; their contour is strongly marked with points or dimples which are very apparent, even on the very squarely angular edge of the frustules (front view).

Biddulphia lævis Rop. Found at Divas (Côtes du Nord) at the mouth of the Rance, at a few leagues from St. Malo. It has also been seen in the neighbourhood of Careutan.

Epithemia succincta Bréb. I discovered this Diatom in June, 1852, at Ouistreham, at the mouth of the canal, which was not then open to navigation. It was growing mixed with *Epith. sorex* and *ventricosa*, on the floating débris of semi-decomposed Ulvaceæ. I named it *Epith. constricta*, and I offered it, under that name, to W. Smith, who was travelling through our country at that time. Occupied at that time with the publication of the first volume of his fine work on the English Diatomaceæ, he inserted *Epithemia constricta*, and figured it in one of his supplementary plates. The drawing was not made from my specimens, but from a different plant of the same. Always seeking to avoid causes of error, I have abandoned the name of *constricta* to Smith's species, and have called the Ouistreham one *Ep. succincta.* It is much smaller than the former; its lateral indentation is also less decided. This strangulation might be only accidental, and not furnish a really distinctive character fit to establish a species. The *Epithemia gibberula*, so common in the Mediterranean, sometimes presents a kind of analogous indentation.

M. Pedicino has figured this state of *E. gibberula*, figs. 10, 20, and 23 of plate 1 of his work on the Diatomaceæ of the thermal waters of the Isle of Ischia.

NOTE.—The preparations mentioned in the foregoing communication having been submitted to Mr. F. Kitton for his opinion, elicited the following observations:—

"I do not see much to add to M. de Brebisson's remarks. I would suggest that the specific name of *Navicula punctata* be changed, as we have already a *Navicula punctulata.* I should, however, prefer retaining the genus *Pinnularia*, and referring to that genus all forms with costate markings. The following are the synonyms of this form:—*Pinnularia tabellaria*, Synopsis of British Diatomaceæ—the longer form of the same species, *P. acrosphæria* of the same work. In a communication from Dr. Arnott he says—'I send you slide of *P. tabellaria*, true, from

Wales, agreeing exactly with Smith's in his slide in the Brit. Mus.; his *P. acrosphæria* turns out to be the longer form of the same seen also here, but most common in the Premnay peat.' I am afraid that the spines of *Surirella Capronii* are of no scientific value, and if not this form must be referred to *S. splendida*.

"*Eupodiscus Gregorianus* is the *Eupodiscus subtilis* of Gregory. It is not a true *Eupodiscus*, but one of the forms of *Actinocyclus* Ehr.; the marginal spines are not peculiar to this genus, and are of no generic or specific value; they may be observed in other genera, notably in *Cyclotella rotula*. This form is not the same as *Coscinodiscus concinnus* of Smith, which is a true *Coscinodiscus*, with delicate hexagonal cellules. It is common in the stomachs of *Noctiluca*.

"*E. Roperiana* is identical with *Coscinodiscus ovalis*. My remarks on the preceding species apply to this form. It seems to me to belong to the genus *Actinocyclus* rather than *Eupodiscus* or *Coscinodiscus*.

"One of the slides marked for *Eupodiscus Gregorianus* does not contain that form, but is the same as the *Navicula punctata* slide. I enclose a slide of *Navicula punctata* (from the Premnay peat) for the Club.

"F. KITTON."

PLATE I.

Fig. 1. *Surirella Capronii*—the form found at Shere by Dr. Capron × 300 diameters.

Fig. 2. *Surirella Capronii*—as found by M. de Brebisson at Falaise × 300 diameters.

Fig. 3. Longitudinal section of valve of the same species × 300 diameters.

Fig. 4. *Navicula punctata* × 600 diameters.

Fig. 5. *Navicula oculata* × 600 diameters.

Fig. 6. *Cyclotella rectangula* × 600 diameters.

Fig. 7. *Epithemia succincta* × 600 diameters.

Fig. 8. *Peronia erinacea* × 600 diameters.

All the above figures drawn from the slides by H. F. Hailes, V.P.

The Crystallization of Hippuric Acid.

By T. Charters White, F.R.M.S., Hon. Sec.

(Read December 17th, 1869.)

In introducing this subject to the Club it will be necessary to call briefly the remembrance of the members to one or two facts familiar to all.

When any soluble substance is dissolved its ultimate atoms are distributed throughout the solvent, and provided the solvent is prevented from evaporating, both solvent and substance remain in the same relation, which is simply that of the most perfect mechanical mixture known, each atom of the substance being imprisoned in a coating of the solvent.

Should, however, the solvent be allowed to evaporate, this relation is disturbed; the substance, if crystallizable, such for instance as Hippuric Acid, is set free to obey certain laws inherent in all salines of forming bodies of definite shapes or crystals; if this process is allowed to take place slowly we get natural crystals of the salt operated on; but if crystallization is forced by evaporation at high temperature the solvent is dissipated before the attraction of cohesion of salt can exert its power, and the result is the formation of an amorphous mass, or if we are dealing with a small quantity on a glass slide we have a semi-transparent film. The attraction of cohesion of Hippuric Acid acts so readily that no rapidity of evaporation of a *hydrous* solution can result in any but the natural needle-shaped crystals; we must, therefore, find solvents of greater volatility, and those from which I have obtained the best results are the strongest and purest spirits of wine I could procure, and the ordinary methylated spirit which, containing a little varnish, seems to act as a retarding agent in the formation of the crystals, so that they are formed more slowly; but even with these solvents every care must be taken to promote the most rapid evaporation by warming the slide, the dipper, and the solution, if we would be successful; the film is then evenly

spread, the attraction of cohesion is locked up, but it soon struggles to be free, and by the absorption of moisture from the atmosphere it regains its power, and dots of circularly forming crystals begin their growth all over the film. This result can be obtained more quickly by holding the slide a little distance above a lamp, or it may be varied by breathing on it, or by alternating each of these processes, or even by alternately heating and cooling the slide at a few seconds interval; by these means Hippuric Acid may be made to assume an indefinite number of concentric forms, which under the polariscope exhibit a gorgeous play of colours.

One striking variety occurs if the crystals are formed at a temperature above 300°; the crystals then become somewhat of the natural circular form, but arranged spirally without going through the usual preliminary film, and they do not display much colour under polarisation. These are interesting in relation to the tendency of some salts to crystalise spirally at high temperatures.

The slides most interesting are those formed at a temperature of about 100°; they will present the most beautiful and varied forms of this Acid, and will furnish crystals that will be much admired either under dark ground illumination or polarised light. Although I have exhibited slides of Hippuric Acid upon one occasion at an extra meeting, I thought it would be as well to bring the subject forward at an ordinary meeting when we have a larger attendance, and when I could receive suggestions from others who have given more attention to the subject of crystallization generally, and when I could answer any questions that might be put to me relative to this Acid and the method of preparing this favourite slide for the polariscope. This must be my apology for bringing forward so elementary a paper on this occasion.

Extra Meetings.—Members of the Club are reminded of the Extra Meetings, which take place on the Second Friday evening in each month, at Seven o'clock. They are devoted to the exhibition of objects, and general conversation on microscopical subjects. During the Excursion season the results of the previous excursion generally contribute to the interest of these meetings.

Observations on the Structure of the Cornea of the Bee.

By B. T. Lowne, M.R.C.S.

(*Read February 25th*, 1870.)

I have lately been engaged in making some sections of the cornea of a large Carpenter Bee from South Africa, which have resulted in my making out several very interesting points of structure.

On referring to my account of the cornea of the fly,* you will find I have described it as consisting of two layers—an external continuous with the external layer of the integument, perfectly transparent, and apparently structureless; and an internal thicker layer, sculptured into facets, or rather into numerous bi-convex lenses, set in a hexagonal framework. This layer, which I believe is continuous with the middle layer of the integument, is too thin in the fly for its structure to be readily made out; nor have I attempted to investigate it.

The section which Mr. Hislop is kindly exhibiting for me is a vertical section of the cornea of the Carpenter Bee already alluded to, and I have found that it confirms what I have said regarding the cornea of the fly. The external layer is far thicker than in the fly, although it presents no trace of structure. It follows the contour of the facets on the surface of the deeper layer.

The deeper layer consists of numerous thin laminæ, each being composed of a vast number of parallel fibres. It further appears to consist of hexagonal prisms, vertical to the surfaces of the cornea, and to the laminæ of which it is composed. These prisms are not, however, separable; although the laminæ and the fibres of which they are composed are easily separated by treating the section for a short time with a solution of caustic potash.

The surfaces of this deeper layer of the cornea may be seen to be covered with convex facets, a facet corresponding to either extremity of each vertical prism, the external facets being, however, best marked.

* Monograph on the Anatomy of the Fly.

In section this layer is seen to be marked by several hundred crenated lines, caused by the laminæ of which it is composed; the crenations follow the contour of the facets, the middle layers being almost or entirely without crenations.

These lines, as well as the indications of the division of the cornea into hexagonal prisms, are best marked in the external portion of the layer. Numerous minute nuclei appear between the laminæ.

When viewed by the aid of polarised light and a selenite, these modifications of structure all become beautifully apparent. Both layers of the cornea polarise, and the colour of the transmitted beam varies from red to green, according to the thickness of the section simultaneously in both.

As I have already stated in my work on the fly, the mesoderm varies very considerably in its structure. I therefore see no reason to doubt the correctness of the views I have already published with regard to the nature of the cornea in insects, whilst the choroid or pigment layer, as I have stated in the same work, appears to correspond to the endoderm, or innermost layer of the integument.

If these homologies be correct, the eyes are undoubtedly integumental organs, with the nerve structures situated between the two inner layers, the principal seat of the terminal loops of the nerves of ordinary sensation.

Excursions for 1870.

The attention of Members is specially directed to the notice, on the cover of this Journal, of the arrangements which have been made by the Excursion Committee for the coming season. It will be observed that during the summer fifteen meetings will take place, seven of which are arranged to fall within the next three months. The first trip will be to Wandsworth Common, which will inaugurate the excursions, on April 2nd, and it is earnestly hoped that a large number of the Members will be found at Clapham Junction on the day named, at three o'clock. The other fixings are for Barnes, Wimbledon, Carshalton, Chiselhurst, Elstree, and Hampton Court. The Excursionists' Annual Dinner, now become an institution of the Club, is down for the 23rd of June, further arrangements for which will be duly announced.

Microscopic Moulds.

By M. C. Cooke.

(*Read March* 25*th*, 1870.)

It would be impossible, within the short space of time allotted for the reading of a paper, to give a satisfactory outline of the numerous genera and species which are included in the term "Microscopic Fungi." Since the establishment of the Club I have several times been solicited by individual members to read such a paper, and hitherto have hesitated in accepting a responsibility which I saw no prospect of satisfying. At length a modification has been resolved upon, and what I could not hope to do for the whole, I am about to attempt for a part. Of the six families into which Fungi are usually divided I have selected the Hyphomycetes; but before commencing with them it will be advisable to recount the features which characterise these six groups or families. It will be borne in mind that four of these families are *sporiferous*—that is, the fruit consists of naked spores—and that the other two families are *sporidiiferous*, or the fruit consists of sporidia enclosed in asci. Of the latter, one family consists of Moulds, which in habit and appearance are often analogous to those we are about to consider, but with a more complex fruit. The other family contains the *Sphæriæ* and their allies, or the *Pyrenomycetes* as they are sometimes termed, and the *Pezizæ* and their allies, or the *Discomycetes.* The majority of these are very minute, and may be truly called Microscopic Fungi, but the 800 British species of ascigerous fungi is far too large a group for such an occasion.

Passing to the Sporiferous Fungi, we have the large forms, of which the mushroom may be taken as a type; the *Hymenomycetes* in which the *hymenium*, or surface which bears the spores, is exposed, sometimes spread over plates or gills, sometimes lining tubes, sometimes covering teeth or spines, but mostly bearing the naked spores in groups of four at the apex of sporophores, or special supports, on which they are seated upon little spicules. We have

again about nine hundred species of these, and scarcely one which can be called microscopic.

The next family is characterised by having the hymenium, and consequently the spores, enclosed in an outer covering, or *peridium.* Such for instance are the puff-balls. These are called *Gasteromycetes* because of this character. Mixed with the spores threads are sometimes developed, and in some cases the spores are formed upon these threads. In the *Myxogastres* the relation which subsists between the threads and the spores has not been satisfactorily determined. Amongst the most interesting genera in this family are *Trichia* and *Arcyria.*

The remaining two families are truly microscopical. The *Coniomycetes*, to which the greater part of my volume on "Microscopic Fungi" is devoted, and the *Hyphomycetes*, to which our attention is presently to be directed. The first of these has the spores as the most prominent feature, and the latter the threads upon which the spores are borne. The "smuts" and "brands" may in some sense be taken as the type of one, and "blue mould" of the other. It is only partly that the common objects I have named can be regarded as types of the two families, because they only represent in many of their features a section of the family. The "smuts," for instance, cannot be accepted as a representative of a *Diplodia*, in which the spores are enclosed in a distinct perithecium, and is a sort of *Sphœria* without the asci; nor of such a genus as *Excipula*, which is *pezizæform*, but without the compound fruit.

Not to weary you with technicalities, or by indicating analogies between forms which I may assume are unknown to the majority of the members, I will proceed to describe the general structure which prevails in the *Hyphomycetes*, or Moulds, hoping that those who are familiar with the subject will, for the sake of those who are not, censure me gently if my observations should seem to be too elementary. There could be no stronger evidence of the small interest which microscopists generally take in this subject than the fact that in a club of five hundred members it was nearly two years before a sufficient number could be induced to unite in the formation of a class for the study, or to obtain the preliminary information necessary for the study, of these neglected organisms. Perhaps in no country in Europe, with equal advantages, are fungi so little known or studied as in Great Britain. There is

evidence of this if we compare our own literature with theirs. The splendid works of Corda and Tulasne have no counterpart with us, except in the less ambitious Cryptogamic Flora of the late Dr. Greville, and the forty years' unrequited labour of the Rev. M. J. Berkeley.

If we examine the decaying stems of herbaceous plants during the winter or in the spring, it will not be long before we discover some grey mould flourishing in patches, and giving off a cloud of spores directly it is shaken or roughly handled. Just such a mould as I have in my mind's eye I have found in little tufts on a decaying portion of the outer husk of the fruit of the Horse Chestnut. This mould always grows in tufts, visible to the naked eye, like a miniature tuft of grey wool; but if we employ a pocket lens for closer examination, that instrument will be sufficient to reveal to us a tuft of shining, dark coloured threads or flocci, supporting clusters of little white spores. Even such an examination, imperfect as it is, cannot fail to impress the observer with the beauty of the object; but if we employ successively a microscope with a two-inch, a one-inch, and a quarter-inch objective, by dint of patience and perseverance we shall be able to make out the entire structure delineated in the diagram. (Plate vi.) This mould is known as *Polyactis fasciculata*, and was first figured and described by Corda in his "Prachtflora." The tuft of flocci or threads is connected at its base with, and springs from, a reticulated mass of delicate branched creeping filaments, which is called the *mycelium.* This mycelium corresponds to the root of a plant, of which the erect flocci represent the stem, giving off branches and bearing the fruit in the form of clusters of spores. Fungi, in all the families, more or less possess a mycelium; it is the base of the vegetative functions of the plant, and however much the complete fungus may differ from others, there is a greater similarity in the character of the mycelium than in any other organ. Sometimes it happens that only a mycelium is produced, growth being checked, and development going no further. At other times barren threads spring from the mycelium, but produce no fruit. In both such instances the plant is imperfect, and it can only be guessing to say what species it might have been had it matured itself. Persons who know nothing of fungi are apt to jump to the conclusion that Mycologists can or ought to be able to give some name for the mycelium or barren threads of any fungus which is put into their

hands. This is demanding more than it is reasonable to expect; and yet there are some who think that mycelium threads, or even joints of such threads, found in different parts of the human body, accompanying certain forms of skin or other diseases, deserve a name and a character, although all the threads and cells ever yet found in such positions may or may not be elementary conditions of some very common mould, such as *Aspergillus glaucus.* The flocci, or erect stem-like threads, which proceed from the mycelium in the *Polyactis* are coloured, whilst in most of the true Mucedines they are colourless. At certain distances these threads have transverse septa throughout their length, and in the upper portion they are branched, the ultimate ramuli or final branches, bearing terminal clusters of spores. When the spores fall away little points or minute spicules are visible to which the spores were attached.

I must beg of you to compare together all the figures before you, and, apart from the mycelium, to recognise the features in which they agree. Of course all of them have fruit or spores; that is the one essential of a perfect plant. A fungus may consist of nothing more than a delicate mycelium and a spore, but without the spore—the great essential—it is an imperfect fungus, and cannot be accurately determined. The most important organ, then, in the determination of fungi is the spore. Young students are cautioned against attempting to find a name for fungi if they cannot first of all find the fruit. In the figures before us we have the spores borne upon threads, which may be very short, almost obsolete, as in *Macrosporium;* or fully developed, but unbranched, as in *Aspergillus;* or branching as in *Polyactis*, and many others. Here we have the features of the family to which these moulds belong—'Filamentous,' or thread-like, 'the fertile threads naked,' or exposed, 'simple or branched, bearing the spores at their apices.' It will be noticed that the spores are *not* enclosed, two or more of them together in a vesicle, as in the fungi of a similar habit belonging to the *Physomycetes*, and this is the only caution needed, for the thread-like form with terminal spores is not met with in any other family.

"Moulds" is a term, then, which I desire you to accept on this occasion as representing the family name of Hyphomycetes, and as including all those filamentous fungi which bear naked spores at the apex of simple or branched threads.

Instead of going to the woods for a second example, let us take

a little common paste which has been exposed a few days, until the surface has become covered with a ropy film. If we try to spread a little of this paste upon paper we are soon convinced of its ropiness, and the microscope reveals the cause. The surface of the paste is covered with an interwoven layer of mycelium. It is clearly the mycelium of a fungus, but whether it is a mould or not, however much we may guess, nothing can be known. In the course of two or three days discoloured patches—yellow, blue, or green—make their appearance. Tufts of woolly threads, some barren, and like little tufts of cotton wool; others of a denser nature laden with minute spores. Everybody calls it "blue mould," and there nearly everybody is content to leave it unmolested, so far as any insight into its structure is concerned.

Under a low power a tuft of this "blue mould" appears as a forest of delicate white threads, with a brush-like tuft of spores at their apices, and under a still higher power the white threads are observed to be jointed or divided by transverse septa, and in the extreme upper portion subdivided into a fascicle, or bunch of short delicate branches, which tend upwards at an acute angle, and are terminated by necklaces of spores, attached to each other like beads, and thus forming a kind of inverted tassel of spores, concealing the branches of the threads, so that nothing is seen but the simple stem and its tassel. When the spores fall away the branches are distinctly visible. This is one of the fungi to which the name of "blue mould" is given, but as that name is also applied to other moulds, we must perforce employ for the future a less ambiguous term. There is a Latin word which represents very well the appearance this little mould possesses. It is *Penicillium* or *Penicillum*—a "painting brush," from whence we derive the word pencil, as applied to an artist's brush. The tuft of spores surmounting the simple stem, like the tuft of hairs in a brush inverted, is well represented by the generic name *Penicillium*. In speaking of this mould, therefore, we must speak of it as a *Penicillium*, since *Aspergillus glaucus*, the "blue mould" of cheese, and other substances, is liable to be confounded with it if the term "blue mould" is employed.

The *Penicillium*, and especially this species, *Penicillium crustáceum*, is one of the most common of moulds. Most of us have some knowledge of a curious, interesting-looking production which is called a "vinegar plant," something like a piece of dirty,

sodden wash-leather, which, being placed in a saccharine solution, induces acetous fermentation, and converts the solution into a sort of Robinson Crusoe apology for vinegar. So long as there is plenty of nourishment the mycelium, of which this production is composed, continues to grow rapidly, but it does not advance beyond that stage; it vegetates, but it produces no fruit. The conditions being altered, it sends up threads which bear necklaces of spores, and the "vinegar plant" proves itself no other than *Penicillium crustaceum.* Ropey vinegar and ropey wine are to be traced to the same source. For experiments in examining and mounting moulds this is one of the best, since it can easily be obtained in an almost unlimited supply at almost any season of the year.

We pass on now to the other "blue mould," which differs materially from the *Penicillium* in the structure of the heads. It is found on all kinds of decaying vegetable and animal matter, and is about the same size. To the naked eye, perhaps, very similar, unless that eye is an experienced one in detecting moulds. The threads are simple absolutely; that is, they are not branched at all at the top, as in *Penicillium*, but instead thereof the top of the stem is inflated into a little globose head, and necklaces of spores are seated upon, and radiate in all directions from this head. This is *Aspergillus glaucus.*

If a tuft of this mould be placed in a drop of water, on a glass slide, and submitted to the microscope the spores will be seen adhering more tenaciously to the apex of the thread than in *Penicillium*, especially those which are seated directly upon the swollen tip. The grumous gelatinous appearance of the head supplies a sufficient reason for this adherence. In another species, closely allied, elongated slender sporophores intervene between the head and the chains of spores.

PLATES IV., V., VI., VII., VIII.

(Continued at page 61.)

PROCEEDINGS.

December 17th, 1869—*Chairman*, Dr. R. Braithwaite, F.L.S., V.P.

The following donations were announced :—

"Land and Water"	from the Editor.
"Science Gossip"	the Publisher.
Two Nos. "Chemical News"	the Editor.
"Report of Excursions" ... ... "List of Members of the Geologists' Association" "The Chief Forms of Cephalopoda," by Rev. Thos. Willshire	the Geologists' Association.
One slide of supposed Skin of Man from the door of the Pyx Chamber, Westminster Abbey... ...	Mr. H. F. Hailes.

The eleven gentlemen proposed at the last meeting were ballotted for and duly elected.

Mr. B. T. Lowne gave a short *resumé* of some of his work during the past year upon the Anatomy of the Fly, and entered chiefly upon those questions relating to its metamorphosis, which his observations had contributed to solve.

The Chairman, in tendering a vote of thanks to Mr. Lowne, expressed his own gratification at the able manner in which the subject had been treated, and complimented Mr. Lowne upon the issue of his new work, which he considered to be one which did great honour to the Author and to the Club of which he was a member.

Mr. McIntire made a few critical observations upon the paper recently published by Dr. Piggot upon the Markings on the Podura Scale.

Mr Lowne was of opinion that the scales consisted of two layers, and that although he had never examined the Podura Scale, yet from analogy he was sure the layers existed.

The Chairman announced that Mr. Sterne, President of the Liverpool Microscopical Club, was present at the meeting.

Mr. T. C. White read a short paper on the Crystallization of Hippuric Acid.

The Secretary read a letter just received from America, the writer of which asked the Club to furnish him with a first-class microscope to aid him in his investigations upon the growth and habits of the cotton worm.

The Chairman thought that the funds of the club were not sufficiently flourishing to enable them to comply with the request.

The Secretary called attention to a beautiful specimen of Photographic Printing by the Albertype process, lent for exhibition by Mr Groves. He also stated that Mr. Groves had again communicated with Herr Albert as to the price of the prints, and found that the amount he had stated at the previous meeting was quite correct.

The following objects were exhibited :—

Crystals of Hippuric Acid (with spot lens)	by Mr. White.
Scales of Macrotoma Major, to show the beaded appearance which is the foundation of the new views of structure of the Podura Scale	Mr. McIntire.
Chigoe (Pulex penetrans)	Mr. Groves.
Dissection of capsules of *Funaria hygrometrica* ...	Mr. Smith.
Various crystals (by polarised light) ... An Albertype Portrait	Mr. Groves.
The New Calliper Eyepiece	Dr. Matthews.

JANUARY 28TH, 1870—*Chairman*, P. LE NEVE FOSTER, ESQ., M.A., PRESIDENT.

The following donations were announced :—

"Land and Water," weekly	from the Publisher.
"Science Gossip"	the Publisher.
"The Monthly Microscopical Journal"	the Publisher.
"The Popular Science Review"	the Publisher.
"The Chemical News"	Mr Suffolk.

The following gentlemen were ballotted for and duly elected :—Mr. Wm. Atkinson, Mr. Wm. John Bull, M.A., Dr. Ed. Dowson, Mr. T. L. Edmunds, Mr. Peter Gellatly, and Mr. Nathaniel E. Green.

Dr. Robt. Braithwaite, F.L.S., read a paper "On the Geographical Distribution of Mosses in Europe," the subject being illustrated by a large and interesting collection of dried specimens.

The President suggested that a hearty vote of thanks be presented to Dr. Braithwaite for his kindness in coming forward to supply the want of a paper, by reading what the club had been favoured with that evening, which was carried by acclamation.

Mr. B. T. Lowne said that at the previous meeting he had referred to Mr. Ray as "the late Mr. Ray ;" he had since found that the gentleman in question was alive, and it was therefore due to him that he should be unburied again.

The following objects were exhibited :—

Diamond Beetle from China	by Mr. Golding.
Foot of Dytiscus, and Gizzard of Cricket	Mr. Conder.

FEBRUARY 25TH, 1870—*Chairman*, P. LE NEVE FOSTER, ESQ., M.A., PRESIDENT.

The following donations were announced :—

"Science Gossip"	from the Publisher.
"Land and Water" (weekly)	the Editor.
"The Monthly Microscopical Journal"	the Publisher.
"The Proceedings of the Bristol Natural History Society" ... ... List of Members of ditto	the Society.
Two Slides	Mr. Conder.

The thanks of the club were voted to the donors.

The following gentlemen were ballotted for and duly elected:—Mr. William James Diss, Mr. Peter Gray, Mr. Henry J. Gray, Mr. W. H. Huddleston, F.G.S., J.P.

Mr. M. C. Cooke read a translation of a paper entitled "Critical Notes on British and Normandy Diatoms," by Mons. Alphonse de Brebisson, corresponding member.

The President, in inviting remarks upon the paper, took the opportunity of expressing his opinion that the members of the club did not usually enter upon the discussion of the papers read before them as warmly as could be desired. Sometimes, no doubt, this might be due to a want of the knowledge of the title of the paper which was to be brought under their notice; but upon the present occasion, a month's notice having been given of the subject, he hoped that some of the gentlemen present had come prepared to favour them with a few observations upon it. Long set speeches were not wanted, but easy conversational remarks would be quite suitable, and would add much to the interest and information of the meeting.

Votes of thanks to the writer and the reader of the paper were then carried unanimously.

Mr. B. T. Lowne favoured the meeting with some observations upon the Cornea of the Bee—the result of some recent dissections of the eyes of a large African species of the Carpenter Bee.

A cordial vote of thanks was given to Mr. Lowne for his communication.

The Secretary called the attention of the members to a number of varieties of *Triceratium* on a slide prepared from Jutland cement stone, which was exhibited in the room by Mr. Golding; a diagram of the diatoms referred to was also exhibited.

Mr. M. C. Cooke said that although he was not learned in diatoms and never professed to be, yet during the last day or two he had been interested in the forms found in the Jutland deposit, from having to prepare some figures for publication, and he might mention that his friend Mr. Kitton, of Norwich, had promised them an almost exhaustive paper upon the subject. He thought that Mr. White was a little in error in referring all the figures in the upper row of the diagram to *Triceratium*; there appeared to him to be several distinct species, one being identical with *Trinacria excavata*, and another with *Trinacria Regina* (plate ii). Those in the lower row were Polycistina.

The Secretary intimated that Mr. Lowne intended to commence a class for the study of Microscopic Zoology, beginning with the Protozoa. The class would meet on Tuesday evenings, at Dr. Power's room in Red Lion Square, the first meeting to take place on Tuesday, March 1st, if a sufficient number of members were enrolled.

The following objects were exhibited:—

Various Crystals (Sugar of Milk, Asparagine, Salicine, &c.) ...	by Mr. W. J. Brown.
Section of Human Tongue (by polarised light) ...	Mr. W. Hainworth.
Diatoms from Jutland Cement Stone...	Mr. T. C. White.
Various Corallines	Mr. Golding.
Crystals of Bichromate of Ammonia ...	Mr. W. Hislop.
Sections of the Eye of a Bee (in illustration of Mr. Lowne's paper)	Mr. W. Hislop.

The President announced that the Excursion Committee had been appointed that evening, and it would be very desirable that any gentlemen present who

knew of suitable localities to which excursions might be made during the summer, should send in the names of such places as early as possible to the Secretary.

Dr. Braithwaite expressed his willingness to assist any gentlemen who purposed taking up the study of Bryology, in naming their specimens; and he hoped that during the coming excursion season many additions would be made not only to the collection of Mosses which was gathered together by the club, but also to that portion of the Flora of Middlesex now in preparation.

The President announced the Annual Soirée at University College, by the kind permission of the Council, on Friday, March 11th.

R. T. Lewis.

ANNUAL SOIRÉE.

At University College, March 11th, 1870.

By the kind permission of the Council, the Club has again held its Annual Soirée at University College, and in no respect was this last inferior to any of its predecessors. The increased number of members since last year compelled the Committee, rather against their will, to reduce the number of tickets allotted to each member, below the allowance of previous years, but there was no other alternative, except in overcrowded rooms. Notwithstanding this reduction, the company was as large as the commodious suite of rooms could accommodate with comfort to the visitors. The sources of attraction were so numerous and varied that the only means by which we can hope to convey any idea of the entertainment is to furnish as complete a list as we have been able to compile of the principal objects exhibited. The Soirée Committee deserve the best thanks of the Club for the success they achieved, and the exhibitors, for supporting them in such hearty and efficient manner.

The following objects were exhibited by members and their friends, in the Library and Museum :—

Allbon, W.,	Weevil, *Coneatus tamarasii.*
,,	Eggs of Parasite of Mallee Bird.
Andrew, A. R.,	Tongue of Cricket.
,,	Under Cuticle of Ivy Leaf, showing hairs.
,,	Ivy Leaf, showing structure of veins.
Barratt, T. J.,	Section of Human Tongue, injected.
Bentley, C. S.,	Kidney of Cat.
Bevington, W. A.,	(No return.)
Blankley, F.,	Hairs of Fern, polarised
,,	New Tank Microscope.
,,	New universal Revolving Stage.
Bockett, J.,	Pollen of Hollyhock, by Ross' 4-inch. objective.
Brabham, T. B.,	Liver of Cat.
,,	Muscle of Mouse.
,,	Lung of Dog.
Brown, W. J.,	Sugar of Milk, polarised.

BURGESS, N.,	*Goniophlebium sepultum.*
,,	Hairs of Comfrey Plant.
,,	Skin of Dog Fish.
,,	Anguinaria dibiloba.
CARPENTER,	Stellate Hairs from Fern, *Niphobolus hastatus.*
CARRUTHERS, W.,	Marshall's Large Double Microscope, as improved by Culpeper and Scarlet (date 1740). (The conclave reflecting mirror was first employed in this instrument.)
COCKS, W. G.,	Animalculæ from an infusion of Sage Leaves.
COLLINGS, T. P.,	Poduræ.
COOKE, G. E.	Fibro-cellular tissue of *Aerides odoratum*, an Orchid, polarized.
,,	Elytron of Diamond Beetle, *Prapodes spectabilis.*
,,	Working Microscope of the late Robert Brown, presented to the exhibitor by the late Professor Quekett. This instrument, one of the earliest Achromatic combinations, is by Amici.
,,	Large Microscope, by Tulley, improved by Powell, with 9-10ths objective (Tulley).
COTTAM, A.,	Fructification of Fern, *Adiantum pubescens.*
CROOK,	Volvox globator.
CROUCH,	Podura Scale, with Crouch's one-eighth Immersion Lens, by 800.
DURHAM, A.,	Portion of Mucous Membrane of human subject, injected.
,,	Section of Brain, injected.
ELDRIDGE, J. R.,	Stamen of Common Mallow.
,,	Feather of English Kingfisher.
,,	Feather of Humming Bird.
EMERY, J. J.,	Circulation in Frog's Foot.
EVANS, E.,	Winged case of Diamond Beetle.
,,	Wing of *Morpho Adonis.*
FURLONGE, W. H,,	Pencil tail, *Polyxenus lagurus.*
FITCH, F.,	Spider's Web, with insects.
FOX, C. J.,	Crystals of Copper and Magnesia, polarised—polarising apparatus rotating by clockwork.
FRICKER, C. J.,	Pollen of Mallow.
FRYER, G. H.,	Floscularia ornata.
,,	Hydra viridis.
GAY, F. W.,	Spine of Turbot, *Rhombus maximus*, polarised.
GOLDING, W. H.,	Stings of Hornet.
,,	Melicerta ringens.
,,	Elytron of Chinese Beetle.
GRAY, W. J. Dr.,	The Chigoe, *Pulex penetrans.*
GROSER, W. H.,	Seed vessels of Fern *(Todea).*
,,	Fruit of *Antirrhinum Orontium.*
GROVES, J. W.,	Chlorate of Potash, polarised.
HAILES, H. F.,	New Foraminifera.
HAINWORTH, W.,	Volvox globator.
,,	Hydra viridis in gemmation.

HANCOCK, J. C.,	Mandibles of Spider.
,,	Crinoline of Lady's bonnet.
HISLOP, W.	Crystals of Bichromate of Potash.
,,	Crystals of Bichromate of Ammonia.
,,	Crystals of Spiral Copper.
,,	Section of Human Brain.
HOPKINSON, J.,	Vorticella nebulifera on Vallisneria.
JACKSON, B. D.,	Zygnema stellina, conjugated filaments.
JAQUES, E.,	Fructification of Hare's Foot Fern.
JOHNSON, J. A.,	Young Oysters.
KIDDLE, E.,	The Ruby Wasp.
,,	Silver Spot Moth, and Eggs of the same.
,,	Antennæ of Gnat, in situ.
KILSBY, T. W.,	Wings of Cricket, with chirping apparatus.
LOWNE, B. T.	External Skeletons of Insects.
McINTIRE, S. J.,	Dichroic effects in scales of *Urania leilus*, a Brazilian Moth.
,,	Pencil tails, *Polyxenus lagurus*, one of the Myriapoda.
MARTINELLI, A.,	Eggs of Lepidoptera.
MATTHEWS, Dr.,	Various Flowers.
,,	Calliper Eyepiece.
,,	Elytra of Beetles.
MILLEDGE, A.,	Scales of Farinosa (Beetle) France.
MUNDIE, G.,	Medusa Polype.
OXLEY, F.	Cyclops and Daphnia.
PERRY, F. T.,	Section of the Toe of a White Mouse.
QUICK, W.,	Lips of Blow-fly, and transverse section.
,,	Gizzard of Cricket.
RABBITS, W. T.,	Foraminifera from the Mediterranean Sea.
RADERMACHER, J. J,	Stellate hairs from Eleagnus leaf.
,,	Pith of a Fern.
,,	Microscope of eighteenth century, and revolving disc of objects.
REEVES, W. W.,	Young Brittle star-fishes *Ophiocoma rosula*.
,,	Ditto *Ophiocoma neglecta*.
,,	Young of Star Fish *Comatula rosacea*.
,,	Ditto *Solaster papposa*.
,,	Ditto *Asterina gibbosa*.
,,	Ditto *Uraster rubens*.
ROGERS, JOHN,	Maple sugar, crystallized.
ROGERS, JOSEPH,	Section of Spine of Echinus.
ROGERS, THOS.,	Eye of Beetle, showing optical image in the lenses.
RUSSELL, J.,	Asparagin polarised.
,,	Circulation in Valisneria, by ¼ inch objective.
,,	Daphnia pulex, by 2 inch objective.
RUSSELL, T. D.,	Skin of Synapta from Channel Islands, anchor spicules and plates in situ.
SLADE, J.,	Circulation of Blood in a Frog's Foot.
SMITH, ALPHEUS,	Pollen of Hollyhock.
,,	Peristome of *Funaria hygrometrica*.
,,	Section of Sugar Cane.

Smith, Jas.,	Disk mountings of wings of Lepidoptera.
,,	Disk mountings of Eyes of Insects.
Suffolk, W. T,	Splinter of deal, 4-10ths objective.
Wheeler, E,	Insects from Ceylon, *Tingis pyri*.
,,	Larva of Ant Lion.
,,	Various Diatomaceæ.
White, T. C.,	Circulation in Young Trout.
,,	Pencil tails, *Polyxenus lagurus*.
Wight, J. F.,	Spider in Amber.
Wright, E.	Egg of parasite of Mallee Bird.

Mr. J. B. Jordan also exhibited his apparatus for cutting thin sections of Rocks and other hard substances, with specimens of rock sections prepared therewith.

Microscopes and Microscopical Apparatus were shown by the following Opticians :—Mr. J. Bailey, Fenchurch-street ; Mr. C. Baker, 244, High Holborn ; Messrs. R. and J. Beck, 31, Cornhill ; Mr. C. Collins, 77, Great Titchfield-street ; Mr. W. Crouch, 51, London Wall ; Messrs. Horne and Thornthwaite, Newgate-street ; Mr. How, 2, Foster-lane, Cheapside ; Mr. W. Moginie, 35, Queen-square ; Messrs. Murray and Heath, 69, Jermyn-street ; Messrs. Powell and Lealand, Euston-road ; Mr. T. Ross, 53, Wigmore-street ; Mr. J. H. Steward, 406, Strand ; Mr. J. Swift, 128, City-road.

Amongst the numerous other interesting objects, were :—

A series of splendid Photographs of Indian Scenery and Architecture, taken by authority of the Indian Government, and kindly lent for the occasion by Dr. J. Forbes Watson, of the Indian Museum.

Photographs of interest were also exhibited by Messrs. A. Durham, Frank M. Good, and A. L. Henderson.

Lithographic Portraits of Eminent Naturalists by Mr. T. Crook.

Fac-similes of Egyptian Jewellery, from Egyptian Tombs, reputed to date about 1860, B.C., exhibited by Mr. E. Kiddle.

British Natural History Collections, shown by Mr. T. D. Russell.

Stereoscopic Views, with coloured illumination, by Mr. W. G. Cocks.

Stereoscopes and Stereoscopic Views, by Messrs. Murray and Heath.

Cases of Stuffed Birds, &c., by Mr. W. E. Dawes, jun.

A very large Collection of Microscopical Objects, by Mr. Edmund Wheeler.

Autotype Photographs, exhibited by the Autotype Company.

In the Shield Room, the Flaxman Drawings were exhibited, by permission of the Council of University College.

Electrical experiments with Induction Coils, Geissler Tubes, Gassiott's Cascades, &c., by Mr. Apps.

The whole process of Micro-Photography by means of the Magnesium Lamp, by Messrs. Solomon.

Dr. Maddox's Micro-Photographs, Alpine Scenery, Statuary, &c., were exhibited by the Oxy-hydrogen light, throughout the evening, by Mr. How.

Microscopic Moulds.

By M. C. Cooke.

(*Read March 25th,* 1870.—*Continued from page* 53.)

One other mould from this order, and I must pass on to the next. It is less common, but perhaps even more beautiful. Sometimes a decaying stem of Burdock, or similar plant, will be found lying upon the ground in a damp situation, covered for two or three inches of its length with a mould of snowy whiteness.

> "Take it up tenderly,
> Touch it with care."

It is so delicate that the slightest breath or shake is sufficient to disperse the spores. Mycologists call it *Botryosporium pulchrum*, and it deserves it. This is one of two British species, neither of which, in my experience, is common. The threads are sometimes simple and sometimes branched, very long for the size of the mould, and flexuous or curved on account of their length. The lower portion of the threads is naked for perhaps a quarter of their length. Above this space short ramuli, or sporophores, are set on at regular distances throughout the rest of the thread. Each of these sporophores is narrowed at its point of junction with the stem; at the other extremity it is surmounted by four little spicules, and each spicule supports a globose head of spores, so that four heads of spores terminate each sporophore, and these together form a compound head. The excellent figure in Corda's "Prachtflora" would give a better idea of this mould than any description that I can furnish.

From these examples it will be evident that much of the generic character of the Mucedines depends on the mode of grouping and attachment of the spores, hence it is of primary importance that all specimens collected or mounted should have the spores *in situ.* Whatever hints I may be able to offer towards securing this object will be given at the close of this paper.

We pass now from the true moulds, which are usually white or coloured, as seen in patches by the naked eye, to those which are always found in more or less black patches, and hence have come to be called "Black Moulds." These are not generally so delicate, the threads are more rigid, and the spores are often more firmly attached. They are found on herbaceous stems, bark, rotten wood, and in fact in a great variety of localities. One of the largest genera, that of *Helminthosporium*, and one of its commonest and finest species, will furnish our first illustration.

Wherever holly bushes are at all plentiful, twigs and branches cut down to stop gaps in the hedges, or that have lain on the ground during winter will usually be freely covered with sooty patches, variable in form and size, but looking just like patches of soot, from the size of a large pin's head to some inches in length. A portion of one of these patches will not make such a neat object or such an attractive one as the majority of true moulds, or even many of the Black Moulds, but it is always advisable to commence an examination with a two-inch or one-inch power.

This Holly Mould will be observed to consist of erect simple threads, bearing spores as long as themselves. The threads are nearly opaque, of a dark brown, paler above and more translucent, jointed and erect. But the spores are the most prominent feature. Often longer than the threads themselves, and at first borne on their apices, they are of a beautiful clear brown, nearly cylindrical, a little attenuated towards each end, or sometimes club-shaped. Throughout their whole length these spores are divided by numerous septa into a number of cells, the largest in any species of the genus with which I am acquainted. The name of this fungus is *Helminthosporium Smithii*. (Pl. vii.) It is dedicated to the immortal Smiths, so that the name of Smith may not be forgotten. Had it been called *magna* or *gigaspora* it would doubtless have been far more appropriate, but such vulgar notions of propriety do not always hover around naturalists when they name a new species. It is a strange infatuation which besets some men thus to immortalise the Smiths. I remember one botanist who made a poor fellow's name do duty, as a specific name, for twenty or thirty new species of plants. But it wasn't Smith.

Dead wood, rotten sticks, dead stems of herbaceous plants, and dead grasses will furnish other species of the same genus. Most of them so nearly alike in the appearance that they present to

the naked eye that the microscope must be resorted to for their determination. In all these species the flocci are dark, erect, and either simple or slightly branched, bearing here and there multiseptate spores. In such a species as *Helminthosporium Tiliæ* the threads themselves seem to enlarge and develope into spores. In some the spores are deeply coloured, in others they are nearly colourless. Near two dozen distinct species have been recognised in this country, and a few more workers would soon increase the number.* It is sometimes objected that the *species* of fungi are imaginary. Let those which constitute the present genus be examined carefully, and it will soon be discovered that the objection had its foundation in ignorance. There must first of all be an appreciation of what constitutes a specific difference in fungi before it can be maintained that there are no good species. It is admitted that only a trifling difference in one or more organs, if comparatively permanent, is enough to constitute a good botanical species. I am content to give up at once any one or more of the British species of *Helminthosporium*, for instance, if it can be shown that what are accepted as the specific distinctions are not permanent, in the sense that permanence is accepted amongst flowering plants. Indeed I incline to the opinion that variability within the limits of a species is less than in the higher plants. The more experience one acquires the more firm becomes the conviction that the general principles of classification in fungi are sound. Of course this does not affect, and is not affected by the autonomy of species. The evidence that a certain form is only a stylosporous condition of an ascigerous species, does not prove that the stylosporous condition is not of itself permanent in its stylosporous character. It is a favourite theme with some who know little, and care less, about fungi, to indicate the proven instances of dimorphism, and jump at once to the conclusion that the study is altogether a chaos, and that there are very few, if any, good species at all. Because what has been known as *Tubercularia vulgaris* is now proved to be a conidiiferous condition of *Nectria cinnabarina*, that does not prove that *Tubercularia vulgaris* is in itself so variable that no reliance can be placed on other species of the same genus, or that the conidia were not sufficiently per-

* A new species was figured and described in the "Gardeners' Chronicle" of March 19th, under the name of *Helminthosporium echinulatum*, which is remarkable for its echinulate spores, all previously known species having the epispore smooth.

manent in themselves to warrant the prior recognition of *Tubercularia* as a good species until its autonomy was placed beyond a doubt. It would have been a very different thing indeed if *Tubercularia vulgaris* could have been shown to have passed into *Tubercularia granulata*, or any other species of the same genus. Such an event would have affected the soundness of specific distinctions, which dimorphism does not.

Passing from *Helminthosporium*, we may sometimes meet with effused velvety black patches, on decorticated oak, which, although similar to the naked eye, are very different in character when seen under the microscope. This is *Triposporium elegans* (Plate viii.). The flocci are also dark coloured, erect, and branched, but the fruit is very different; it consists of tri-radiate articulated spores. Recently, Mr. Broome has found these spores with swollen and rounded tips; a circumstance from which it would at present be premature to draw conclusions. Nothing of the kind is known in *Helminthosporium*. The *Triposporium* is, then, something like a *Helminthosporium* with compound spores. Other species are found in other parts of the world, and this seems to strengthen the genus as perfectly distinct from *Helminthosporium*. It will be time enough to doubt its generic value when some one has demonstrated the tendency to a similar form of fruit in any good species of *Helminthosporium*.

Amongst the numerous and interesting fungi which are found growing on dead stems of nettles, there is one which may be alluded to as exhibiting a variation in the structure of the stem, which is found also in some other genera of the Black Moulds (*Dematiei*). I allude to *Arthrobotryum atrum*. The stem is in this instance a complex one, composed of numerous threads, or flocci, which are collected together and combined into a common stem, which seem at first to support a globose head of spores, but upon closer examination each of these spores will be seen to have its own proper stem or thread, and by their agglomeration the spores assume the form of a more or less globose head. In the present instance the threads are swollen above, just at the point of junction with the spores, and the spores themselves are nearly elliptic, divided by transverse septa, with the central portion brown, and the terminal joints colourless. A similar species with smaller spores is found on willows, and what I think is an undescribed species, on decaying grass and straw. Here, again, in

the structure of the stem, we have a decided generic difference between these species of *Arthrobotryum*, and those of the other genera alluded to.

The dead stems of such umbelliferous plants as the common Hogweed, Angelica, &c., also nourish Black Moulds, and one of these may be taken as the type of another genus. I allude to *Dendryphium fumosum*, figured by Corda under the name of *Dactylium fumosum*. The branched threads in this species (Plate v.) are surmounted by large and beautiful elongated fusiform brown spores, which are transversely divided by numerous septa. One peculiarity in their mode of growth is that the spores are produced in chains; that is, one spore supports another at its apex. This concatenate condition of the spores is not always readily made out, because the attachment is so slight that unless great care be exercised, only single spores will be found attached to the threads. In some other species the attachment is more permanent.

By comparing together the examples I have given of the *Dematiei*, the general features of the order will be readily apprehended. The threads are free, or sometimes collected together so as to form a compound stem. They are also more or less furnished with an outer membrane, which may often be seen peeling off in the flocci of *Helminthosporium*, and have a burnt or charred appearance, never white or of pure tints, as in the *Mucedines*, and the spores have frequently the same carbonized or brown tint. The distinctions between these orders are, I think, manifest in the characters I have given.

These are the two largest orders in the family to which they belong, but there are four others, each containing a few genera, to which I must allude. A few years since our worthy secretary, at that time, called my attention to some cat's dung which was found in one of his cellars. It was covered with a curious-looking mouldy substance, but there were no heads, and the thick snow-white coralline threads had a peculiar powdery appearance. When examined under the microscope, these threads, or branching stems, were found to be composed of a mass of delicate hyaline threads, bearing a profusion of powdery minute spores at the surface. It was *Isaria felina*, found for the first time in Britain. A similar structure prevails through the order to which this species belongs. The common stem is compound, and the powdery spores are borne on the surface, giving the fungus a peculiar pulverulent appear-

ance. It is not uncommon to find dead pupæ of insects and dead spiders bearing similar compact moulds; but these are now admitted to be conidiiferous states of Entomogenous Sphæriæ, belonging to the genus *Torrubia.* Probably several others have a similar development, although the condition is at present unknown.

That very common red fungus which is found at this time of the year on almost every rotten twig, *Tubercularia vulgaris*, may serve as a well-known example of the *Stilbacei.* It is, doubtless, entirely a spurious genus, that is, the species which compose it are but conditions of other forms, yet it is common, and fairly illustrates the order to which it has been assigned, whereas species of the genus *Stilbum* are not always to be met with, especially when they are wanted. In *Tubercularia* there is a somewhat globose head and a short stem, sometimes so short as scarcely to be recognised. This stem, and also the head, is entirely composed of slender compacted threads, and the surface of the head is covered with very minute gelatinous spores, which form an investing stratum. As this species is so common, I would advise everyone to make the examination for themselves, and thus they will understand the structure infinitely better than from mere description. It represents a compact complex mould, and in general appearance has no resemblance whatever either to the true moulds, or the black moulds, though more closely related to *Isaria.* From the stroma of this *Tubercularia* its perfect form (*Nectria cinnabarina*) will often be found emerging.

Another very common fungus, found on nettle stems, which again is a condition of a higher form (*Peziza*) belongs to this order. It appears in small orange-coloured spots on the stem, swollen and gelatinous when moist, but flattened into a little waxy spot when dry. In this instance the receptacle is like a disc, and in the perfect condition it becomes a shallow cup. It is much more gelatinous and tremelloid than the *Tubercularia*, but equally common. From one of its prominent features it is named *Fusarium tremelloides*, and not long since it was included amongst the *Tremellas.* Let me advise everyone to take the opportunity of a stroll or an excursion during this month or the next, and examine the nettle stems which have stood through the winter, especially in a damp situation. Near the bottom of the stem, often running half-way up, they will discover myriads of little orange spots the size of a pin's head. If a piece of this stem be brought away, and

the end placed in water, if not already moist, then as soon as the little points appear convex and gelatinous, remove one on the point of a penknife, flatten it upon a slide by pressure on the cover, and examine the structure with a quarter inch, adding a drop of water at the edge of the cover when the object is well in focus, then look and learn. Of course those whose sole ambition is a pretty object, and nothing more, need not trouble themselves, as they are likely to be disappointed.

I will not detain you over the remaining two orders, as they are of little importance. In the *Sepedoniei* the flocci are so much suppressed that the spores seem to be the principal feature. Perhaps the only true genus represented in Britain is *Fusisporium.* It is very doubtful whether *Sepedonium*, *Epochnium*, and *Psilonia* are not soon doomed to oblivion. The spores in *Fusisporium* are long, spindle-shaped, curved and septate, forming a gelatinous mass.

In the last order *(Trichodermacei)* the spores are invested by the flocci, forming a sort of spurious peridium. The most common and typical species is *Trichoderma viride*, which forms at first whitish, then greenish, mouldy tufts on dead wood and fallen branches. This is the only British species of *Trichoderma*, and the Messrs. Tulasne have shown it to be a condition of *Hypocrea rufa.*

From these cursory observations you will gather that, considered in the light of microscopical objects, two orders of the *Hyphomycetes* only can be strongly commended to your notice. Of course those who are desirous of extending their knowledge of the lower forms of vegetable life will not rest content with such only as may be attractive ; but I am afraid that there exists too little interest in the subject for me to hope that many are prepared to pursue the study of Fungi, except under the most favourable conditions and with the most attractive forms. It will prove a source of satisfaction if I am disappointed.

The collection of moulds requires to be conducted on similar principles to the collection of other objects, and no special instructions are needed, except on one point. Moulds are exceedingly delicate, and cannot be bottled or placed loosely in a vasculum ; indeed, if each specimen or species is to be of value it must be isolated from all others in such a manner that the spores of one cannot by any accident become intermixed with the flocci of another species. To avoid this I find it advisable to employ small

boxes, chip boxes will serve, with corked bottoms, or small insect collecting boxes, and, as soon as a specimen is found, carefully to cut away all extraneous portions of the leaf or stem of the plant on which it is growing, thrust a pin through it, and fasten it in the cork of the box as one would a butterfly or moth. If the specimen is a very delicate one the box must be carried home in the hand, if the mould is to be secured in prime condition. The greatest care must be taken in trimming up the matrix of the mould to employ a sharp knife and cause as little jar or vibration as possible to be communicated to the mould, or the spores will be dislodged.

Supposing that the mould is safely conveyed home, the next subject for consideration is how to examine or mount it. The true moulds or Mucedines are the most delicate, and require the greatest care both in collection and preservation; if moderate success be achieved with these all the rest is easy. On no account must moulds be placed in fluid of any kind for examination, or all the spores are instantly removed, and nothing is left but the bare flocci; this may be necessary for the examination of the threads themselves, but it is fatal to the mould.

Cells of any kind, tin cells, glass cells, vulcanite cells, or any other cells, fixed upon glass slips are the best for the purpose. A small portion of the mould, carefully removed with a sharp pair of scissors, taking care not to touch the mould, but to cut the leaf or stem, and remove the fragment with its portion of mould attached, and at once place it in the cell, fix it or not as taste may dictate, and put on the cover, fastening it in position with a spring clip. I should not myself fasten down the thin cover for twenty-four hours, in order that what moisture there might be in the mould or its matrix might find its way out. If closed at once the glass is liable to become dull, and remain so for some time, on account of the evaporation of the enclosed moisture. Such a slide will, if neatly manipulated, prove a most attractive object for a low power, say one or two inches, especially if well illuminated.

To examine a mould satisfactorily it must be mounted free from compression, and it must be seen as an opaque object. Further, it should be seen with the amplification of a quarter-inch objective to make out the details. Here then is the great difficulty. To examine an opaque object under plenty of light with a quarter-inch, and such a quarter-inch of good penetration. Some will

advocate perhaps a Lieberkuhn, or similar mode; my own impression certainly is that we are deficient in the means of viewing opaque objects satisfactorily with a quarter-inch. I must confess that I can do no good with a Lieberkuhn on a quarter-inch; perhaps I may be a bungler. One great objection which I have, for my purposes, to modern and good English high powers, lies in the quantity of metal which the makers give us. A small nozzle is required, the smallest possible, so that with side reflectors and condensers we might get light, whereas usually there is greater breadth in the quarter-inch than in the inch, hence we get more light with the German powers, because the "nozzle" is smaller. (If I may use such an undignified term as "nozzle,") I would suggest to some spirited maker the manufacture of a quarter-inch with the smallest possible diameter at its extremity, so that all those who, like myself, believe in objects seen as they are, without having the light thrown through them, may gratify their depraved (?) tastes.

And now, as to the examination of moulds in the best way we can, under existing circumstances with high powers. A smaller portion, consisting of but two or three flocci carefully removed, and placed on a glass slip, covered and fastened down forthwith without the slightest movement of the glass after it has touched the object, will sometimes give a moderately good slide for the quarter-inch. The heads of spores will be broken or distorted, and other allowances will have to be made; but this is the only way in which I have been able to make out the structure, for instance, of the sporophores of such a mould as *Botryosporium*.

The "Black Moulds" and some other of the *Hyphomycetes* are far less delicate than the Mucedines, and many of these, as *Helminthosporium* and *Macrosporium*, might be mounted in balsam, although I think that very few indeed of the Microscopic Fungi are not much better in diluted glycerine—the cover being fastened down with gum dammar dissolved in benzole—than when mounted in that medium, in Deane's gelatine, or in balsam. Some persons have a mania for balsam, but it is clear to me that the miserable collapsed spores and threads of specimens mounted in balsam, when I had less experience, are only caricatures of the things themselves in a state of nature, or even when preserved in diluted glycerine.

Already I find that my remarks must close without reference to a very important subject, which it was my intention to have in-

cluded—namely, the dimorphism of Fungi—especially as associated with moulds. It is, however, of so extended a nature, and my observations would necessarily reach to some length, so that I am compelled to postpone until another occasion the consideration of these phenomena. As examples I might mention *Dactylium dendroides* (Pl. iv.) amongst the Mucedines, and *Cladosporium herbarum* as one of the Black Moulds.

Pl. IV.—Dactylium dendroides.
Pl. V.—Dendryphium fumosum—after Corda.
Pl. VI.—Polyactis fasciculata.
Pl. VII.—Helminthosporium Smithii.
Pl. VIII.—Triposporium elegans—after Corda.

GATHERINGS AT EXCURSIONS.

The following is a list of the gatherings I made at the Excursion to WANDSWORTH COMMON on 2nd April:—*Stephanoceros*, very abundant and large; *Melicerta ringens* also; *Floscularia*, not many, and apparently young; *Limnias ceratophylli*, *Vaginicola crystallina* (green, double-bodied), plentiful; *Tubicolaria* a few; *Vorticella chlorostigma*, plentiful; *Stentor*, very large a few; *Volvox globator*, abundant, disintegrated; *Actinophrys oculata*, moderately abundant; *Euglena viridis; Hydra viridis*, very bright green; a curious *Amœbiform Protozoon*, continually changing, like frosted silver, under a spot lens, the granules constantly moving like the swarming of *Closterium; Difflugia*, *Rotifers*, *Pandorina morum*, *Staurastrum*, *Cosmarium*, and *Docidium*, the last three conjugating; with a goodly number of *Statoblasts*.—T. C. WHITE.

CARSHALTON, 14th May.—The following were collected:—*Melosira nummuloides*, *Spirogyra quirina*, *Tardigrada*, *Navicula cuspidata*, *Navicula didyma*, *Paramecium aurelia*, *Fragillaria capucina*, *Gomphonema acuminata*, *Meridion circulare* (seven or eight frustules), *Pinnularia oblonga*, *Euglena viridis*, *Pandorina morum*, *Epithemia turgida*, *Cypris tristriata*, *Rhabdonema arcuata*, *Chætonotus larus*, *Noteus quadricornis*, *Rotifer vulgaris*, *Canthocampus minutus*, *Metopidia triptera*, *Tabellaria flocculosa*, *Surirella bifrons*, *Pinnularia oblonga*, *Conferva flocculosa* (with zoospores, and in conjugation), *Diatoma vulgare*, *Synedra splendens*, *Synedra capitata*, *Nitzschia lanceolata*, *Nitzschia longissima*, *Pleurosigma Spenceri*, *Vorticella nebulifera*, *Ulothrix mucosa*, *Pinnularia radiosa*.—J. M. RAMSBOTHAM, M.D.

On Ciliary Action in Rotifera.

By N. E. Green.

(*Read April* 22*nd*, 1870.)

The subject of ciliary action in *Rotifera* cannot but be interesting. The movements of these wonderful hairs—which seem to perform not only the duties of hands and feet, but to supply the place of all the five senses combined—are the first to attract attention when looking at this phase of animalcule life as exhibited in the microscope; and when an earnest examination of the nature of these movements is commenced, the study acquires a fascination peculiarly its own.

In order somewhat to systematise the treatment of the subject, we propose to divide the general action of cilia into groups, speaking first of those hairs which occupy a forward position, and are thus placed nearest the source of supply. These, for want of a better name, we will call "informers," their apparent duty being to ascertain the state of the surrounding water, and give timely notice of the approach of food. We will, then, offer a few observations on the construction and movements of those wonderful crests of undulating cilia, usually called the wheels, from whose action a continuous supply of nutriment is derived, and brought within reach even of those occupying a fixed position. From these we will pass to a consideration of those cilia which examine, and receive or reject, the various particles drawn in by the action of the wheels, and from this important duty deserve well the title of "inspectors;" and conclude the paper with a few remarks on the cilia which line the gullet, and whose occupation is evidently to thrust forward the food into contact with the gizzard, or, in the absence of this organ, to make it up in pellets suited for home consumption.

The cilia which we have called the informers, and whose duty appears to be to convey information of the state of the surrounding water, are few and short in the common rotifer, and long and

abundant in the floscule, but each animalcule of the wheel-bearing class possesses them more or less. In the common rotifer they terminate the process which extends from the head when the wheels are withdrawn, and may be seen in frequent vibratory action, as though testing the condition of the water, while the body of the creature is moved here and there in search of food. When their report is encouraging, out come those wonderful appendages and work as usual; but should the result not equal the expectation, they are withdrawn, and the informers again employed. We have observed this action particularly in those individuals which had been kept for some time in a limited supply of water.

In Vorticella, Brachionus, Philodina, and especially in Melicerta Floscularia, and Stephanoceros these hairs may be observed, and in each case their duty seems to be somewhat the same. Those accustomed to watch the movements of Vorticella may have observed the manner in which that beautiful anterior fringe of cilia, which assists in the formation of the vortex, is sometimes thrown forward, straight and motionless, though but for a moment; but if its answer is not satisfactory, another jerk is given, and a fresh examination made before the rotatory movement is set up. Again, in Melicerta, how many weary moments have we spent in watching those tufts of short cilia, which just peep over the edge of the case when the animal is retracted, and are evidently designed to convey information of any change in the surrounding medium—this may be tested by allowing a few drops of fresh water to pass over the end of the case, for soon the influence is felt, and the creature comes slowly out to realise the benefit of the change. But without some explanation of this kind, it seems difficult to assign a duty to those infinitely delicate threads which radiate from the head of the floscule—these would be little better than unnecessary excrescences if some useful work is not performed by them.

With regard to the wheels, we will first make a few observations on the direction of the movements of cilia, by which the illusion of rotation is produced, and then speak of the duplicate character of the organ itself; and if in these remarks we simply repeat the statements of others, even this repetition is not destitute of value, for on a subject of such intricacy, every independent testimony is acceptable. We have watched both earnestly and long to discover the nature of these rotatory illusions, and not until the animalculæ had been kept in the same limited supply of water, and

their action reduced by this means to a fitful or languid movement, could we arrive at a satisfactory conclusion; but at last an opportunity was afforded in the case of a very fine Stentor, who found trade so bad that he had shut up shop, and seemed inclined to retire from business altogether, but was induced to recommence operations by the stimulant of a little fresh water. The movements of the cilia were at first so slow and deliberate that the action of each hair could be easily followed. Before the addition of the water the fringe extended upright and motionless from the head, but as the reviving draught passed over it, first one hair and then another bent slowly towards the centre of the disc, returning to the upright position at a still more leisurely pace; then two or three would follow each other gently in the same movements—soon a whole side went down, but in a progressive wave, resembling the action of wind on a field of corn; and, in less time than is occupied by the description, this movement became circular, including the whole of the fringe, wave after wave passing round it in the most beautiful and regular manner, till at last the waves followed each other in such rapid succession that the eye failed to follow them individually, and the illusion of the rotatory movement was complete.

On one occasion, when watching a Vorticella, the wave was observed to rise and fall like the sullen beat of surf on the sea shore, and as a wave, when falling at a slight angle with the coast, will sometimes seem to dart along the shore a mile in a minute, so when the movement of the cilia has been most deliberate the wave has appeared to pass round the fringe like a flash. We might multiply instances, but the conclusion to which we come in all, is, that each cilium moves in a very elongated oval, that the greatest energy of its action is inwards, that the movement is progressive, one hair following very rapidly upon another, producing the appearance of a wave, and that these waves following each other round the circle of cilia effect the illusion of rotation; this illusion being most complete where each cilium moves most slowly, viz., on the outer edge.

This peculiarity of illusion is most evident in the common Rotifer, Philodina, Brachionus, and Melicerta, for in these animalculæ the individual cilia are longer, and have a whip-like character, the lash recurving in its stroke over the ridge on which the cilia are placed. But in the Vorticella the wave-like movement is so

rapid in the anterior row, that the fringe itself disappears, and what is usually seen at the margin of the cup is simply a vibratory movement of the stouter hairs of a second or posterior series.

We cannot leave this subject without referring to a charming scintillating movement, observed in *Conochilus volvox*, when the action is ceasing; it results from an energetic stretching out and momentary rest of each cilium, when at that part of its action furthest from the centre. The effect of this momentary rest is to produce a radiating and progressive scintillation, the beauty of which is beyond the power of description, and must be seen in order to be appreciated.

During these examinations we frequently observed a duplicate arrangement of the cilia forming the wheels; this first attracted notice in the vorticella, for when their movements became languid an inner and an outer row were clearly seen; the inner long and close set, extending from the bell like a silken fringe; the outer fewer in number, stouter in form, and radiating from the centre. It was also evident that the two rows were not always in action at the same time, for in some instances a movement in the inner circle preceded that of the outer, and in several instances the inner was observed in slow action, while the outer remained stationary. We have already remarked that the peculiar appearance at the margin of the cup seems to be due to a vibratory movement of this outer series, and a careful examination will make this evident, for the extremes of action are marked by a ghost-like cilium, and between these there may be observed a faint fan-like cloud, produced by the passing and re-passing of the cilium over the intervening space. This movement is evidently very different from that of the wheels. Truly wonderful is the power possessed by this atom, feed it with a little indigo, and observe the vortex formed by its action; the particles are drawn in on all sides as by a maelstrom, while a long stream of rejected matter is thrown off like smoke from a steam tug. May not part of this amazing energy be accounted for by the united action of the two fringes of cilia, the anterior drawing in, while the posterior drives off in all directions?

But to proceed. We have observed this double series or some modification of it in Stentor, Brachionus, common Rotifer, Philodina, Vaginicola, &c., and in a former paper mention was made of a similar series in Melicerta. In the common Rotifer, Philodina, and Brachionus, the second series is placed under a fold of the

crest from which the anterior fringe proceeds, and is chiefly instrumental in taking up particles drawn in by the front series, and conveying them to the mouth, while in Melicerta the second series is placed on the back of the lobes, and the waving movement, instead of being in one direction only, as in the outer fringe, is in two directions, both leading to the gullet.

In all these instances we have been speaking of a movement which, however bewildering, is still distinctly visible; but there is one member of this family in which the means by which the food is induced to come in, is invisible, at least to any but a most close and patient observer; we allude to the floscule. How often have we been surprised to see a monad swimming in all the unconsciousness of animalcule life, in the neighbourhood of one of these creatures, taken as it were with a temporary fit of insanity, and precipitate itself into the bell-like mouth, when a slight contraction of the neck indicated that it was all over with the unhappy monad. Surprised we have been indeed, and sorely puzzled to divine the cause of these strange movements, or to make out the hidden source of their power.

Slack, in his charming work, "Marvels of Pond Life," page 76, refers to this power in these words: "Some internal ciliary action, quite distinct from the hairs, and which has never been precisely understood, caused gentle currents to flow towards the mouth in the middle of the lobes," &c.; and in Prichard's standard work, page 667, Gosse is quoted as an authority: "That in Floscularia rotation is accomplished not by the tufts of long setæ, but by cilia set, on the inner surface of the disc." This seems very definite, but we read again, page 675, with the authority of the same name, "That the setigerous lobes are not the true rotatory organ, yet there is a rotatory organ, the particles of floating matter revolving in a perpendicular oval within the mouth of the disc, hence I conclude that the rotatory cilia are set in the inner surface of the disc."

We find from these quotations that both Slack and Gosse have regarded the precise situation and nature of the rotatory organ of the floscule as still open to investigation. Having been supplied by our good friend, Mr. George Fryer, with a stock of these interesting creatures from his tank, we set to work to unravel the mystery; but many means, and kinds of illumination were tried without avail. There lay the beautiful floscule, apparently motion-

less, yet the mad gallop of the monads continued, some driving backwards and forwards before the opening to the mouth, but meeting on every side an almost impenetrable series of setæ, were at last compelled to enter; here we have seen three or four at a time awaiting their fate, when presently the ominous contraction of the neck is given, a beak-like process advances from the centre, and with unerring aim seizes on each in succession. Most provoking, certainly, and not to know anything about it. So, to work again, this time trying dark ground illumination with $\frac{4}{10}$, and by this means much was learned of the quiverings, shudderings, or strikings of the setæ; these movements were sometimes so continuous and effective that both Mr. Fryer and the writer thought that the seat of power lay in the shorter spurs of setæ, which extend far into the bell-like opening; but a more prolonged examination made it evident that these movements were employed rather to keep the passage clear, or to increase the current, than to form the current itself, for this still continued when the setæ were at rest.

At last, having given them a few days to consider whether they would yield their secret or no, we commenced operations one evening about eight, on a specimen extended bell-upwards, and working so slowly that some particles of indigo with which it had been regaled on a previous occasion, were flowing slowly over the brim into the cup, and coming out again at an equally steady rate. The resolve was immediately made to trace the course of these particles, being assured that wherever the hidden cilia might be, there the movement of the indigo would be most accelerated or disturbed. Many particles were watched in succession; they passed unmoved over the shorter setæ, where, on other occasions, we had seen them driven about in wild confusion; but on arriving at the contraction of the neck, and just at that part where the interior bulges out into a wider form, they were invariably agitated, some passing over it with a jerk, while others were returned in their course, thus completing the perpendicular oval referred to by Gosse. Those particles which had passed this rim were observed to cross leisurely over the flattened surface which surrounds the mouth; but in coming out were again disturbed or jerked, some, indeed, were retained and agitated in such a manner that an imaginative eye might readily have seen the cilia by which their dance was produced; but being in a very matter-of-fact mood, we only felt assured that *there they were*, if we could only see them. Still, after some hours of effort,

and trying every available power and kind of illumination, we were about to give it up once more, when, wandering over the slide without any definite intention, we came upon an unusually fine individual, this time stretched longitudinally, and in steady work. The immediate neighbourhood of the ridge was, of course, the part scrutinised, and again the dance of the indigo was observed, and every now and then, the eye seemed to catch the usual flash-like action of cilia. We had been working with an exquisitely corrected quarter-inch by Dalmayer, and with the usual light transmitted through a quarter-inch achromatic condenser. The former power was exchanged for a $\frac{1}{6}$ by Ross, and the condenser adjusted with great care, when, on bringing this power into focus on the further side of the chamber, and then raising it in the most delicate manner, so as just to focus that which lay above the surface, our eyes were feasted on the sight of a row of cilia in active operation. Yes, there they were!—one, two, three, we could almost count them round a portion of the curve; short, thick-set, directed towards the mouth, and busily engaged producing the current, the cause of which had baffled us so long. The hour was near twelve, and the eyes had been more than once bathed with cold water to enable them to bear the strain, so the gas was turned out, and we prepared to turn in, well satisfied with the result of our four hours' search.

Since this time we have on several occasions verified the foregoing statement, a careful examination of the same locality having seldom failed to reveal these mysterious hairs. Still, we would desire to caution any of our friends, who may wish to see for themselves, that there are peculiar difficulties in the way of success. It is in vain to try on an individual fresh from a free supply of water; the action is too rapid, a slide must be kept for some days in order to reduce the energy of movement. Then it must be remembered that the cilia are placed just where it is most difficult to see them (see Plate ix.), and the thickening of the integument or side of the chamber makes it doubly difficult to separate so delicate an object from the side itself. The only available situation, at least in our experience, is that described, viz., the inner surface of the further side.

But our programme would be incomplete without some reference to that very useful body of cilia which we have termed inspectors, whose duty is to examine the general mass of particles drawn in by the action of the wheels, to select that which is suitable for

food, and reject the remainder. It is truly wonderful what an amount of work they get through, considering the mass of material which is constantly thrown on their hands, or, we should rather say, their fingers. In Melicerta there are two cushions, each armed with a phalanx of active cilia, which guard the entrance to the gullet; and when the supply of nutriment is too abundant they close over the opening, and thus save the gizzard from repletion. But in Brachionus, Philodina, and the common Rotifer, the inspectors may be seen as a distinct series of hairs, and their duty is unmistakeable.

When a particle has passed this ordeal it is allowed to enter the gullet, where it is immediately taken up and hurried forward to the gizzard by those cilia which line the passage, and whose action is so constant as to raise the idea of running water.

In a Brachionus a very peculiar movement was observed in the throat when the stock of food was getting short. The cilia seemed to form themselves into a writhing, tongue-like process, the movements of which resembled a flame. This was sometimes thrust towards the gizzard, and again turning in its course, stretched forward to the mouth, as though anticipating the needed supply.

It may also be observed that a movement of the cilia in the gullet precedes the throwing out of the wheels; and that in the case of a poor Melicerta who had been evicted, this internal action continued long after all exterior effort had been abandoned.

When the gizzard is wanting, a most important duty seems to be assigned to the last of these internal cilia, viz.—the making up of the food into pellets. In some species of vorticella this has been distinctly seen, the movement reminding us of that which is observed in the mold of the Melicerta. The food seems also to be amalgamated with some secretion of the animal, for instead of mingling with the matter in the interior, it retains its globular form. These pellets are then passed forward by a general action of the interior, and reduced in size by absorption till they approach the exit, where they sometimes coalesce before they are discharged. The cilia covering the bodies of such creatures as the Stentors, are evidently of great value, as by their continued action they cause these discharged matters to pass away, which otherwise might accumulate, to the great annoyance of the animal.

But we have not quite done with ciliary action yet, and this last instance is, in our experience, unique. A rotifer re-

sembling the Pterodina of Pritchard, was once seen furnished with a wheel-like movement at the end of its tail, so that its locomotion might be likened to that of a paddle-wheel steamer with an auxiliary screw. By this apparatus at the end of the tail it attached itself to the glass or weed, and the rotatory movement then ceased, but recommenced some seconds before departing in search of a better situation.

We have thus sketched the general characteristics of ciliary action in Rotifera, commencing with those occupying the most forward position, and concluding with a singular instance of their presence in the rear. May we not, ere we close, consider for a moment the infinite perfection displayed in their arrangement, and the exquisite adaptation of the means to the end ?

When these and similar investigations are made in a spirit of scientific research alone, how keen is the enjoyment, how pure the delight; but if, while contemplating the wonders of the creature, the mind is raised in adoration to the Creator, then indeed is the cup of pleasure full.

Could the secrets of but one road-side pool be told, oh ! what an anthem would arise to the great Original; and if our hearts are in tune with nature, we shall ever be ready to join the chorus in praise of nature's God.

Coming Excursions.

The Excursions of the Club for the coming quarter are for July 9th, Barnet for Totteridge, to meet at King's Cross Station; July 23rd, Bromley for Keston, to meet at Ludgate Hill Station; August 6th, Thames Ditton, to meet at Waterloo Station, main line; August 20th, Grays, to meet at Fenchurch Street Station; September 3rd, East End for Finchley, to meet at King's Cross Station; September 17th, Snaresbrook, to meet at Fenchurch Street Station. In all cases by the earliest train after two o'clock. The Excursion Committee hope that they will be encouraged by the presence of a large number of members.

On a New Method of Substage Illumination.

By Dr. J. Matthews.

(Read 27th May, 1870.)

I must confess to a feeling of considerable difficulty in introducing the subject of my paper of this evening to your notice. I had been at work many months upon it, when it suddenly came to my knowledge, about three weeks since, that I had fellow-workers in the field, and that we had all arrived at results very nearly alike, by similar means. Nay, more—that those means had been hinted at or foreshadowed in the pages of Carpenter, Hogg, and others, and even employed by Tollit and Davis. But my experiments were then complete, so that I think I may fairly claim to be at least one of the first who has employed these new agencies, and applied them in a formal and convenient way to the microscope, so as to facilitate their use and give precision to their results. But previously to laying before you these results it may not be out of place to notice briefly the present modes of substage illumination.

First is the plane or concave mirror—reflecting daylight or lamplight, and in so doing absorbing about half the incident rays, to the great detriment of its use with the higher powers, besides giving images from both front and back surface so that the direct light of the lamp was often substituted—an excellent plan, easily applicable to almost all cases.

Next is the prism, either rectangular or equilateral—bounded by plane surfaces—first employed in the Newtonian telescope. This was a great advance, as by it nearly all the rays are reflected, and there was only one image given. Amici and Abraham curved the two surfaces opposite to the reflecting face of the prism into a lenticular shape, by which it became a condenser as well as a reflector; a most valuable improvement, especially in that of Abraham who made his achromatic. The "Diatom prism," of Mr. Reade, is of the former kind. All these (except that of Mr. Abraham) possess more or less of these faults; that they do not reflect light

equally at all angles, and notably least at the most oblique—a circumstance fatal in practice—and that they impart colour to otherwise colourless objects, either by refraction or probably some amount of polarization and *perhaps* diffraction.

"Nachet's" prism—in which light is taken from the plane mirror (but not necessarily so), conveyed by two internal reflections to its apex, which is surmounted by a plano-convex lens, and thus converged on the object—is another form of great merit, for it condenses oblique rays and is so mounted as to throw them in any azimuth by a revolving fitting. But, as its angle is unvarying, it has not been attended by the advantages expected.

It was speedily found that in none of these methods is sufficient light reflected in the use of the higher powers, so that it became necessary to devise some means of concentrating more light upon certain objects under certain requirements. Out of this necessity grew a new, complicated, and expensive instrument, called a condenser. This certainly fulfilled its purpose well, too well in fact, for in the blaze of light thus collected, nearly, if not quite, all definition was lost. This speedily demanded and obtained a remedy, though it was, as I shall presently endeavour to show, of the most objectionable kind. And here arises an involuntary sigh of regret that so much ingenuity of arrangement, such delicacy of construction as is displayed in the condensers of our best English microscope makers, should be expended in such a wrong cause, in such an erroneous direction, while, as is too often the case, the remedy lay at our very feet, unnoticed and neglected!

Condensers are of two kinds, though similar in principle and but slightly varying in construction.

Firstly. One or more lenses interposed between the mirror and the object, *not* achromatic. Of this kind Mr. Reade's "Kettle Drum" is a good illustration, and being reasonable in cost and not difficult of use, has been found very serviceable.

Secondly. One or more lenses, also interposed between the mirror and the object, but perfectly corrected in all respects in the manner of the best objectives. Of this form the admirable instruments of Messrs. Beck, Ross, Powell and Lealand, Baker, Crouch, and others are good examples, as well as, though last not least, the excellent arrangement of Webster, on and by which most of my earlier experiments were made. It is very efficient, besides being the simplest and cheapest form; no small consideration, I surmise, to

many who hear me, as well as, I confess, to myself. And here it is the place and now the time to aver that economy in apparatus has ever been a prime motive in my experiments, provided that efficiency and accuracy were not thereby impaired. In this I think that I have succeeded almost beyond my most sanguine expectations.

I may just observe, by the way, that we have heard very much lately of the results of some other mode of illumination, of which the means have not as yet been published. This is to be deplored, as secresy is the enemy of true science, and surely that secresy is unworthy which, while proclaiming results, does not indicate means!

The great and important question now presents itself of the real and true meaning of the word definition, since it is that, in combination with resolving power, at which scientific microscopy should aim. It means, I conceive, to put it as tersely as I can, "The power of correct appreciation of light and shade in reference to form, structure, and colour." And its completeness depends mainly upon the angle at which light is incident on, or passes through an object, as well as upon the amount and quality of that light.

It was speedily found, as the microscope approached perfection, that axial light did not fulfil all the conditions necessary for definition, and so men, almost instinctively, turned the mirror out of the axis, in order to get the effect of oblique illumination, finding that more details were thus secured. Just on this principle, astronomers observe the moon in her phases instead of at the full, knowing that in the former case her surface has more of appreciable detail.

This was perfectly easy as long as the mirror or the prism in any form were employed. But when the condenser was substituted, the conditions altered—the light once more became axial, and then "definition" was impaired, if it were only from the great increase of light incident in such a direction that it resembled the examination of the moon at her full, instead of in one of her phases. To meet this, certain contrivances were employed called "stops," consisting of a diaphragm so mounted excentrically as to present certain variously-shaped openings in the axis of illumination. Some of these were "spots," some mere slits or "slots" in one azimuth; others slots in two directions, so as to divide and admit light in two or more sets of rays.

The effect was that in the case of the spot stop a hollow cone of rays resulted; in others, oblique rays in one, two, or more, azimuths. Certain markings in so-called test objects were thus displayed, but no one knows to this hour, with any certainty, what their nature is, simply because the light which should fall on them *im*partially, if I may use the expression, is only used at the will of the observer, in certain arbitrary directions. No wonder that some one said to me, very recently, " You can make any appearances you please with oblique illumination !"

It seems to me practically absurd first to concentrate all the light you can on an object, then to complain that there is so much, and in such a wrong direction, that you cannot *properly* see it; and next to proceed to cut off $\frac{3}{4}$ths or $\frac{4}{5}$ths of that light in the hope and expectation of seeing better what you want to see ! And yet this is done every day, when we use a condenser with spots or stops of any kind. In the spot stop, the case is more peculiarly unreasonable, for then we get oblique rays certainly; but as they are in every azimuth at once they *must* neutralise each other in a great degree. I am even of opinion that for this very reason the means of centering used with condensers were a mistake, and that they have probably worked at their best, when they were *not* centered.

Let us, therefore, go back to first principles. Let us consult nature.

Let me ask any astronomer *when* he sees the moon best ? *What* is the nature of his difficulties in the observation of the planets ? Is it not in the first case when she is *not* in the full, and do not his difficulties in the second partly result from the opposite reason— that they are always at the full, the source of light in both cases remaining unalterable at his will ? I ask of any photographer *when* he can get the best effects out of a landscape, when the sun is behind his camera or at its side ? I think that I need not doubt of the answer. And now comes the important question. How is (what I think I may fairly call) this misapplication of that good thing, the condenser, to be remedied ? I reply, *not* by interposing stops or arbitrary openings of any kind in the path of the beam of light, in order that by cutting off some of its rays, either radially or centrally, the rest may be left oblique ; but by making *the whole bundle* oblique. Let me explain in what way and by what agency.

Mr. Ross lays it down as an axiom quoted by Mr. Hogg on the

microscope, "That the manner in which an object is lighted is second in importance only to the excellence of the glass through which it is seen." This opinion I most heartily endorse, and that literally, by adopting one of the objectives themselves, of lower power, as an illuminator in place of a condenser, but not axially. It must be so mounted as to send the whole of its bundle of rays at angles varying with the requirements of any given case, and in this consists the value of the method which I now introduce to your notice.

Any of the powers may be used, bearing in mind that the higher the examining, the lower, within convenient limits, should be the illuminating power, in order to secure a proportionate amount of light. The only use of condensers of short foci and wide angle is to get the more oblique rays of the cone by stopping out some part of the rest. My best results have beeen procured by a two-thirds or one-and-a-half object glass, which give in all cases quite sufficient light.

There is no limit for the angle at which the illuminator may be used in relation to the axis of the instrument short of 90°, supposing both the covering and the mounting glass as well as the stage to be of no thickness; but as they all have a very sensible one, and it is found that rays of a greater angle than about 83° do not pass through the slide to the object, but are reflected and lost, I have found it better to work at angles varying from 25° to 65°.

The objections which I have to urge against the use of very oblique angles of illumination are as follows:—1st. Supposing thin covering and mounting glass to be used on wooden slips, the shadows are likely to be so extended and long as to blend each with the following, and so confuse the image. 2ndly. That if the mounting slip be of the average thickness, it serves as a refracting medium (like the earth's atmosphere during the setting of the sun), into which rays of extreme obliquity enter; but from which very few emerge. And 3rdly, that in both cases much light is lost by the dispersion of rays over a larger surface than would be covered by the same number of rays at a lower angle.

You will find a very useful and instructive paper by Mr. Hislop on this subject in No. 3 of the "Club Journal," to which I refer you.

In relation to this part of the subject Mr. Ackland has made a

most valuable suggestion; viz., to interpose a double concave lens in the cone of rays formed by the objective condenser before it reaches the object. There is no doubt that by these means much light will be saved, since the rays will be rendered parallel, so that fewer will be reflected by the under surface of the slide of that part of the cone of light most obliquely incident on it.

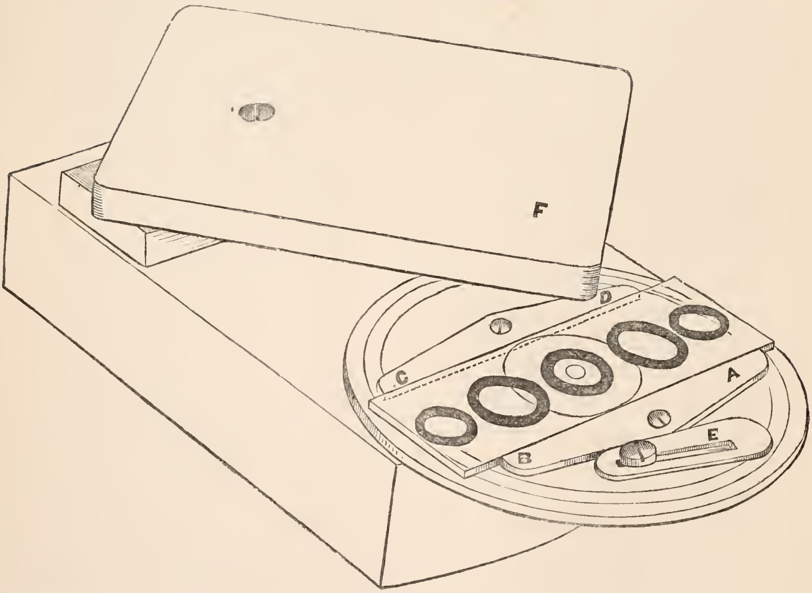
And now as to the results. There are, I think, gentlemen present who can confirm me in the assertion that they have been most gratifying and valuable. It was hardly to be expected that in this—the infancy of the idea—with new manipulations to be ascertained and mastered, new powers developed and perhaps new appearances correctly interpreted, this method should exhibit its superiority as speedily as it has done; yet at even the very first attempt I had the pleasure of resolving tests, which had been quite impossible to me with the same powers previously. I will not occupy your time by any attempt at enumeration of the objects which I have thus observed and defined with unusual ease, for I am of opinion that ocular demonstration is far better. I have, therefore, placed a microscope on one of the tables, fitted up so as to show my method, and Mr. Hislop has very kindly promised to help me. We may not at first, while the management of the instrument is new to us, be able to show all that we could wish; but I quite believe that we shall, all of us, very soon be able to dispense with other modes of using condensed light. One of its happy developments is, that we can at will, effect an excellent dark ground illumination with objectives of almost any power or angular aperture, by merely adjusting the illuminating power at a slightly greater angle, easily determined by experiment. I had hoped to be able to tell you that polariscope effects might be obtained together with dark ground illumination; but my in-investigations on that subject are as yet so far from complete that I will not now lay them before you.

The objectives which I have used are some by Beck, Ross, Powell, and Lealand (an immersion of great excellence), Merz, as well as one by Mr. Crouch of the same kind, with the performance of which I was much pleased. You will be gratified to hear that the cost of this useful addition to any microscope need not exceed 25s., and that a substage is by no means necessary for its application, while the cost in those instruments not having one need not exceed 15s. to 20s., and further that any

intelligent maker can see almost at a glance how it can be effected. I have hitherto used direct lamp light only; but it is quite easy to adapt a prism or mirror for the convenience of those who prefer daylight. I need scarcely say that I shall be happy to give my plans for either form to those who may wish it.

I will not occupy your time any further now, for I fear that I have trespassed too much on your patience already. I had much more to say, but think that I may well leave it for a future paper, if the subject prove interesting to you.

Most of those around me know my profession, and may easily imagine, therefore, how little time I have at my disposal for carrying out investigations which require an uninterrupted leisure. If, however, what I have said shall induce others who are not similarly fettered to take up the subject, but with greater skill, knowledge, and experience than I can pretend to—and I see many such before me—my purpose in jotting down these observations will have been answered, and I shall leave this place to-night contented and happy.



DR. MATTHEWS' IMPROVED TURN-TABLE.

Improved Turn-table. By J. Matthews, M.D.

(Read 27th May, 1870.)

It may be of interest to members of the Club that I should describe briefly to them my new form of turn-table, or cell machine, by which slides are held and centered, as regards their width, at the same time, leaving their surface entirely free, so that two, three, or more cells may be formed in their length. Everyone who has used the present machine must often have felt the inconvenience of the springs; sometimes too strong, at others too weak, always in the way, catching the fingers or the pencil, and limiting the number of cells. Centering is also so uncertain that several ingenious remedies have been proposed and used with varying success; but none have entirely supplanted the old form devised by Mr. Shadbolt, now in use. My plan is simple in the extreme, consisting of two jaws of the average thickness of a glass slide, $\frac{3}{8}$ of an inch wide $2\frac{1}{2}$ long. Each of these is pivotted on the face of the turn-table by a screw through its centre, each screw being placed exactly equidistant from the centre of the turn-table, so that the jaws are separated by a space as wide as an average slide; *i.e.*, a full inch. Outside of that space, on one side of the centre of one of the jaws, is a wedge fixed by a screw, in such a way as to be capable of motion in the direction of its length by a slotted hole. This is all the machinery. A B and C D are the two jaws, E is the wedge. On placing a slip between the jaws they probably at first do not touch it. If the wedge be then pushed so as to approximate B to C, the jaws move on their centres, so that however far B may be pushed towards (and moving) C, the other end of C—*i.e.* D—is moved *exactly* as much in the opposite direction until they approach near enough to grasp the slide by its edges. The length of the wedge must, of course, be such as to provide for about $\frac{1}{8}$ of an inch variation in the width of slides. It will readily be seen that the slip may be pushed in either direction excentrically lengthwise, so as to allow of the formation of any number of cells, all of which *must needs* be central as regards their width, if the instrument has been accurately made, which is a very easy matter. I have added also a rest for the hand, F, which may be turned aside on a centre at will, and which I have found to be a great convenience. Its price need very little, if at all, exceed that of the old form.

PROCEEDINGS.

MARCH 25TH, 1870—*Chairman*, P. LE NEVE FOSTER, ESQ., M.A., PRESIDENT.

The following donations were announced :—

"Science Gossip"	from the Publisher.
"The Monthly Microscopical Journal" ...	the Publisher.
"Land and Water,"	the Publisher.
Four Volumes of "The Popular Science Review"	Dr. R. Braithwaite, F.L.S.
Twenty-one Slides of Diatoms in illustration of his paper read February 25th	M. Alphonse de Brebisson.
Two Slides of Hairs of Lion and Mantchurian Deer	Mr. C. Bennett, Junr,
Seven Slides of Atlantic Soundings, 3,600ft. to 14,400ft.	Mr. R. T. Lewis.

The thanks of the Club were voted to the donors.

The following gentlemen were ballotted for, and duly elected members of the Club :—Mr. Edmund Burkhart, Mr. Robert Spring Garden, Mr. Thomas Hyde Richardson, and Mr. Francis L. Smith.

Mr. M. C. Cooke read a paper "On Microscopic Moulds," which was illustrated by a large number of coloured diagrams and by specimens exhibited under the microscope at the close of the meeting. A quantity of specimens of several kinds of Fungi were placed upon the table for distribution amongst those members who felt interested in the subject.

The President proposed a vote of thanks to Mr. Cooke for his very interesting paper, which was carried by acclamation.

Mr. Edward Richards exhibited and described a newly-devised method of using Darker's Selenites, by which the different films were placed entirely under the command of the observer—the construction of the apparatus was rendered more intelligible by a large model in wood, and the practical application of the various combinations was shown to the members at the close of the meeting.

The President said that all the members who were present at the recent Soirée must have a very grateful sense of obligation to those gentlemen who exhibited objects on that occasion; he, therefore, asked for a vote of thanks to them for their efforts on that occasion.

Dr. Braithwaite seconded the proposal, which was carried *nem. dis.*

The President said that members would, no doubt, recollect that a fresh arrangement with regard to the issue of the tickets for the Soirée had been carried out this year. It had been found that on former occasions the crowding was very great; and to prevent this it was this year resolved that only one complimentary ticket should be given to each member, but that any members

who wished to bring other friends could be supplied with additional tickets at 2s. 6d. each. It was not intended by this arrangement to put money into the pockets of the Club, but merely to restrict the number of tickets issued. On this occasion the money received for the sale of tickets amounted to £5 7s. 6d., and the Council have resolved to present this sum to the funds of University College Hospital (great applause). The manner in which you have received this announcement shows how heartily you approve of the manner in which this amount has been applied.

The President announced the meetings and field excursions for the ensuing month, and the proceedings terminated with a *conversazione*, at which the following objects were exhibited :—

Poppy Seed	by Mr. Golding.
Test objects, shown with new immersion ⅛in.	Mr. H. Crouch.
Borate of Ammonia, crystallized in various forms	Mr. G. Conder.
Diaptomus Castor (a fresh-water Crustacean), and *Botryosporium pulchrum*	Mr. Hainworth.
Euglena Viridis	Mr. Martinelli.
New Apparatus for using Darker's Selenite Films	Mr. Richards.
New and Compact Binocular Microscope, specially designed for travelling	Mr. Moginie.

April 22nd, 1870—*Chairman*, Dr. R. Braithwaite, F.L.S., V.P.

The following donations were announced :—

"The Monthly Microscopical Journal" ...	from the Publisher.
"Science Gossip"	the Publisher.
"The Popular Science Review"	the Publisher.
"Land and Water" (weekly)	the Editor.
"Good Health," Nos. 8, 9, 10	the Publisher.
Annual Report of the Geologists' Association	the Association.
"De la Motilitie des Conferves"	
Descriptive Catalogue of 100 Objects exhibited at the Soirée of the Royal Microscopical Society, and List of 60 Objects from Deep Sea Dredgings, exhibited by Dr. W. B. Carpenter	the Royal Microscopical Society.
Proofs of Illustrations to be published with Mr. Suffolk's Lectures	Mr W. T. Suffolk.
One Slide—Gizzard of Cockroach	Mr. T. C. White.
Four Slides—Borate of Ammonia ... ... One Slide—Starch of Calabar Bean	Mr. G. Condor.
"The American Naturalist," vol. iv., Nos. 1 and 2...	in Exchange.

The thanks of the Club were voted to the donors.

The following gentlemen were ballotted for, and duly elected members of the Club :—Mr. William Adams, F.R.C.S., Mr. A. Horsley Bossy, Mr. Charles Barrett Barnes, Mr. William Black, Mr. John Foster, Mr. John Michels, Mr.

Alfred Green Lang, Mr. Thomas Jeffery Parker, and Mr. William Ford Stanley.

Mr. N. E. Green read a paper "On Ciliary Action in Infusoria and Floscularia," illustrated by a diagram.

The Chairman proposed a very cordial vote of thanks to Mr. Green for his paper, which was carried unanimously.

A member observed that Mr. Green had mentioned a little difficulty, which had frequently occurred to himself, and that was the pronunciation of scientific terms; for instance, the e in Genus was pronounced long in the singular, but short in the plural; and in the word Fungi, some people made the g hard and others soft. He had often felt puzzled as to which was correct, and should be glad to know if there was any rule for guidance in such cases. He mentioned the subject to Dr. Carpenter a short time ago, and the answer to his inquiry was, "Well, there is no accounting for these things."

The Chairman said that there was really no guide in such cases as those mentioned. There were certain rules as to quantities where a vowel comes before two consonants, final es, and some other instances, but beyond these the matter greatly depends upon custom or taste.

Mr. Hainworth inquired of the reader of the paper what illumination was used with the one-sixth inch objective with which he saw the cilia?

Mr Green replied that he used a condenser with the usual illumination.

Mr. Curties believed that Mr. Green used an ordinary objective as a condenser.

Mr. Green said he used an ordinary $\frac{1}{4}$in. objective, adapted by Dallmeyer for the purpose.

Mr. White said that having heard how to observe the *Floscularia*, no doubt many of the members would be glad to know where to get them. The round pond in Kensington Gardens was a place where they were very abundant, and he had obtained them from it at all times of the year.

Mr. Gay said this pond used to be a good place for them, but that he had tried several times lately and could not find any there.

Dr. Braithwaite suggested that it would be a question whether these cilia were common to all infusoria.

The Chairman said that he wished to bring under the notice of the members the formation of a new Microscopical Society at Croydon. Mr. Henry Lee, the President, was a member of this Club, and at the first meeting of the Society nearly a hundred members were enrolled. No doubt they would have excursions during the season, which, he thought, might be made mutually advantageous by arrangements to join with the Club on different occasions.

The Secretary mentioned that he had been told that the Croydon Society were looking forward to the excursion of the Club to Carshalton on May 14th, in the hope of being able to join with our members there; he was sure that by uniting in this way the usefulness of these excursions would be increased, and mutual information gained.

The following objects were exhibited:—

Melicerta ringens	by Mr. Hainworth.
Fredricella Sultana	Mr. Oxley.
Gizzard of Cockroach	Mr. T. C. White.
Gizzard of Cricket	Mr. Quick.
Diatoms Mounted Opaque, by Möller ...	Mr. Curties.

Mr. S. J. McIntire said that he had never seen the gizzard of the Cricket exhibited so nicely as in Mr. Quick's specimen—it was transparent and cut circular.

May 27th, 1870—*Chairman*, Dr. R. Braithwaite, F.L.S., *V.P.*

The following donations were announced :—

"The Monthly Microscopical Journal"	from	the Publisher.
"Science Gossip"		the Publisher.
"Land and Water" (weekly)		the Publisher.
Report of the Surgeon General U.S.A. on the Magnesium and Electric lights as applied to Microphotography, accompanied by eleven Photographs in illustration of the results obtained by both means. ...		Lieut.-Colonel Woodward.
Two Slides. Sections of Granite from Mount Sinai.		Mr. Keddle.
Twelve Slides. Various.		Mr. Quick.
The American Naturalist, Vol. iv., No. 3.... ...		by Exchange.

The thanks of the Club were voted to the donors.

The following gentlemen were balloted for and duly elected members of the Club :—Mr. H. G. Brigham, Mr. George Dransfield Brown, Mr. Henry Hayward, Mr. T. W. Horne, Dr. Henry Medlock.

Mr. Waller read a paper "On the Conjugation of Actinophrys Sol," illustrating the subject by diagrams.

The Chairman was sure that all would join him in proposing a hearty vote of thanks to Mr. Waller, for his able and interesting paper, which was a challenge thrown down to members, so many of whom at this season of the year were engaged in collecting. They would, no doubt, notice that it was not sufficient to look at the specimens and then throw them away ; they must keep on observing them carefully at short intervals to meet with success. There had been many writers upon this subject—one of the principal writers, Kölliker, does not allude to this method of conjugation described by Mr. Waller, but refers their reproduction to the process of gemmation. Dr. Wallich, however, in 1863—some time after Mr. Waller had made his observations—noticed this process, and thought at the time that it was fission taking place ; but on looking a short time afterwards he saw that the two individuals had become one, and then he became satisfied that it was conjugation, but he did not appear to have noticed the escape of the small bodies seen by Mr. Waller. These observations were very interesting, from their bearing upon the question of the distinctions between the animal and vegetable kingdoms. Some of the small algae or fuci were known to reproduce by conjugation. No one else appeared to have seen the eruption of granules observed by Mr. Waller ; it was a most interesting observation, which, it was hoped, would be repeated, so that an opportunity might be given for examination with higher powers than those yet employed, for the purpose of ascertaining whether they were furnished with cilia. With regard to the leaping of a species, to which reference had been made in the paper, he believed it might easily be explained by the elastic nature of the Pseudopodia, the motion caused by which might easily be mistaken for a leap, under the microscope.

Mr. T. C. White expressed the happiness he had in seconding Dr. Braithwaite's vote of thanks, and he hoped that many of the members would follow the example of Mr. Waller, who had not only made a series of careful observations, but had also made drawings of what he had seen—a matter of very great importance. It was suggested some time since, after the reading of a paper by

Mr. Draper, that there should be a Quekett Club Portfolio, to contain the drawings made by members from their original observations, and he was very desirous of seeing this suggestion carried out. Mr. Waller further deserved the thanks of the meeting for his desire to be a *useful* member of the Club ; he hoped that many more members would be stimulated with the same desire, and would give the results of their observations to the members at the meetings—there need be no fear that subjects might not be interesting, for all might rest assured that, if interesting to themselves, it could not fail to be interesting to others when communicated ; for interest in a subject was undoubtedly catching.

Dr. Matthews introduced and described a new form of turn-table, and read a paper "On a new method of sub-stage illumination."

The Chairman, in moving a vote of thanks to Dr. Matthews, expressed the pleasure he had felt in listening to his remarks, and characterized the improved form of turn-table as one of the most ingenious contrivances he had yet seen for the purpose.

Mr. S. J. McIntire said that he had the pleasure a short time since of spending an evening with Dr. Matthews, and was much pleased with the results obtained by the new method of illumination. He had himself been for some time working with one of Powell and Lealand's achromatic condensers, and took this with him for comparison, but was not very successful in using it on that occasion. He would not, however, say that the new method was better than his own condenser, but the difference in the cost was considerable, being only that of the means for fixing one's own object-glass below the stage, and he might say that thus the best results could be obtained for twenty-five shillings.

Votes of thanks to Mr. Waller and Dr. Matthews were then carried unanimously.

Mr. Curties said that he had the misfortune to be one of those persons described by Dr. Matthews as "fettered beings," but he had however been able recently to make an excursion on his own account, and it was to the Admiralty, at Whitehall. Having to wait some time he found that one side of the waiting room was covered by a picture containing about 600 microscopic forms drawn by Lieut. Palmer, during one of his voyages. Feeling sure that this waiting-room was not well known, he thought it would be a matter of interest to many of the members to hear of what was to be seen in it. The picture is of large size and represents many forms from the animal kingdom, as well as those of surface ocean life and microscopic life met with during the voyage ; in addition to the objects there is a chart showing the course of the vessel, every care being taken to give the temperature of the water with the latitude and longitude where the dredgings took place. In reply to a question from Mr. Ruffle, Mr Curties also stated that the picture could be viewed by any person who visited the place.

The Chairman directed the attention of the members to a very valuable addition to the library of the club, the whole of the First and Second Series of the Annals of Natural History, which had been recently purchased at a moderate cost, and which could not fail to be of great service to many members as works of reference.

The Secretary announced that the following objects were exhibited :—

Teeth of Leech	by Mr. Conder.
Test objects, shown by the new mode of sub-stage illumination	Dr. Matthews.
Head and Eyes of Spider	Mr. Golding.

Special attention was also called to a number of very beautiful coloured drawings of the eggs of Lepidoptera and other microscopic objects kindly lent for exhibition by Mr. Millett.

R. T. Lewis.

Observations on the Conjugation of Actinophrys Sol.

By John G. Waller.

(*Read 27th May*, 1870.)

I feel some diffidence in communicating the result of observations made just nine years ago, because, in that interval, the number of observers with the microscope has so greatly multiplied that I cannot hope to tell you much that is new. But the subject is of acknowledged obscurity, as, indeed, is the case with the life history of all those humble organisms that seem to stand at the base of animal life. If, therefore, I merely confirm the observations of others, some little service may be done. Moreover, I have no hypothesis to support; all I undertake to do is to record what I saw and what I noted down with my pencil and pen at every stage. I shall also show you that, at the time my observations were made, there was no certainty among those, either at home or abroad, who had written upon the subject, but merely a chaos of conflicting evidence.

In April, 1861, I made a gathering at Woodford Bridge, in the river Roding, and the ditches adjacent. It was a very rich one. It contained diatomaceæ and desmideaceæ in abundance, as well as many other specimens of microscopic algæ. Two varieties of hydra—*Hydra vulgaris* and *Hydra viridis*. Two or three varieties of amœba, with many allied organisms, amongst which was the Actinophrys Sol (Sun animalcule), taken from a dusty scum on the surface of a ditch. Being more interested at that time in diatoms, I did not at first pay so much attention to this particular gathering, and did not examine it completely until May 7, when, in putting a drop of water upon a slide, I discovered six individuals of the actinophrys grouped together around an empty cyst, in the midst of which was a small diatom. (Pl. x. Fig. 1.) I at once made a drawing of it, and observed it for some time; not, however, noting anything more remarkable than that all seemed adherent together, floating without any volun-

tary motion, either as a whole or in the individual members; except, however, and this is important to note, that the six individuals were really in three conjugating groups, and each group did change slightly its relative position, but it was by a passive kind of motion, backwards and forwards, showing that the bodies were only adherent together, and had no such union as was the case with the pairs conjugating; and I am inclined to think that the group, together with the empty cyst, may have been an accidental circumstance, and was not connected with the life history of the organism.

I was, however, unable to conclude my observations thoroughly, being called away, and the water evaporated before I could return to it, as it was not covered. But my interest was now fairly roused. I took another drop of the water, and finding many of the animalculæ conjugating, made a drawing of one example, which seemed as in the act of separation. (Fig. 2.) One individual exhibited a protuberance or budding, as if in gemmation; but whether that had any relation to the phenomenon of conjugation I had no means of proof; what I observed in this instance being merely the act of separation, which I watched until its completion, making drawings from time to time. (See Figs. 3, 4, 5, 6, 7, 8.) It was slow and gradual, and apparently effected chiefly by the mere force of gravitation. As it proceeded to completion the band of union became more and more attenuated; at length it twisted in opposite directions, much as one twists a piece of thin cord to break it, and finally portions of it snapped asunder, and then each gradually withdrew the broken band into its own substance. During the extension of the band, and also in the peculiar manner in which it ultimately broke, leaving a ragged edge, I recognised a remarkable semblance to India rubber when a small piece is drawn out until it breaks, and thence concluded the substance to be very elastic. I did not witness any further phenomena, although I watched for some time the individual which seemed to be in the condition of gemmation. In fact, here again I had been careless enough not to protect the water from evaporation, and it dried up just as I had noted an increased development in the gemmule, and had recorded it by a drawing. (Fig. 9.)

The question now arises, and which is one of the difficulties of the subject, was it fission or was it conjugation, with the result a gemmule and a subsequent separation, that I had witnessed? I did

not see, either the beginning or, in fact, the complete ending. Nor do other observers, as far as I am aware, appear to have been more fortunate. If fission, it can be understood by analogy, but if conjugation, I shall be able to show you that it has another and a very different issue.

On the following day I made another observation, and one by far the most interesting, and to which I especially direct your attention. This time I took care to avoid untimely evaporation, and placed the water upon the capillary tablet.

In this instance, I was attracted by noticing that an apparent change was taking place in two individuals in the act of conjugation. I remarked that the tentacular processes were being withdrawn, and that a more intimate union of the two coalescing bodies was taking place. Having satisfied myself of the fact, I made a drawing of this stage. (Fig. 10.) It was 4 o'clock p.m., and I watched the object from time to time until 7 o'clock, when scarcely a vestige of any of the processes were visible, and the two bodies had become one, ovate in form, but still retaining a mark of separation. (Fig. 11.) Half an hour afterwards there was but little of such mark left (Fig. 12), and three hours after that, viz., at 10.30 p.m., it was one circular mass, with but a slight remnant of the tentacular processes; all had been withdrawn. (Fig. 13.) On the following morning at 8 o'clock there was but little apparent difference, only that neither processes nor retractile vesicle were now visible. About half an hour afterwards, I noticed a slight fidgetty movement going on in the interior of the substance, like as if some minute bodies were endeavouring to escape, which gradually increased until they burst forth, (Fig. 14), having a rapid gyrating movement, which, as they came into focus, showed them to be ovate in form, and of a dirty yellow colour; but whether ciliated or not I could not detect. They poured forth so rapidly, and in such numbers, as to fill the field of the microscope, until at length a pellucid envelope seemed to burst, portions being protruded at each end, which spread out exactly as an amœba; indeed, anyone would then have imagined it to have been that organism. This took place at 9.30 (Fig. 15); a short time afterwards the operation ceased; the portions protruded like pseudopodia were withdrawn again into the substance, which now became quiescent, but was very different in appearance and character. It seemed to be a circular mass of coarse granules, without any sign of life, and of a rough irregular outline, and had

lost its colour (Fig. 16). Thus I left it at 10 o'clock, and throughout the day not the slightest change took place. I let it remain under observation for twenty-four hours, but it was still the same; and it was obvious to me that all life had ceased, as not a particle changed either its form or position.

I now sought for information on the phenomena I had witnessed; and taking down from my shelves the last edition of Pritchard's "Infusoria," proceeded to examine the summary there given of the knowledge of this interesting organism; and on which I think myself entitled to offer some criticism, and first on that division which treats of "conjugation."

"The remarkable act of conjugation," says the editor, "also known as *Zygosis*, has attracted very much attention in the class of animalcules under consideration, among which it is of frequent occurrence. Much discussion has taken place concerning the purpose of this process. Most of its early observers considered it a reproductive act, a sort of copulation between the two individuals; but the tendency of opinion at the present day is to deny it this nature, and to treat it as little more than an accidental phenomenon, without apparent object or aim. Nevertheless, its occurrence is so frequent, and the process of so complete a character, that it is hard to believe it to be in vain, and to no purpose in the economy of the *Actinophryina*." Surely the observations here given endorse the correctness of the latter view. But the writer proceeds to say, "A difference of opinion likewise prevails as to the nature of the process, one set of authors maintaining that there is an actual fusion and intermingling of substance between the conjugating animals, whilst another party asserts that there is *no* fusion, but merely a temporary adhesion or accretion between their bodies." Kölliker describes this fusion, and speaks of it as of a reproductive character. The facts I have given you seem, to my mind, to point to the same conclusion; but the summary in Pritchard's "Infusoria" concludes in this most indecisive manner:—

"The balance of authority and evidence is against the supposition of its reproductive purpose; but when this view is rejected, we have no other to replace it, and are sensible of the want of sufficient data from direct observation before a hopeful attempt can be made."

You have before you the result of conjugation producing, I think I may presume to say, "embryonic germs," this term being one I take from several observers who have evidently seen at least this

part of the phenomenon, although some may have somewhat incorrectly described it. Stein, Kölliker, and Mr. Weston all maintain that there is a reproduction in "Actinophrys" by "germs." That the minute ovate bodies were living beings there cannot be the smallest doubt; what their development is remains a problem, to be solved, I hope, by some members of the Quekett Club.

Now, then, as to what is called "fission." The separation of two individuals, such as I have described, seems to be the same phenomenon that some eminent observers have termed "fission." If so, the term "conjugation" must not be applied here. But my observation gives us no proof, as I did not see the commencement of the phenomenon, and it is a point well worth the attention of our numerous members. The difficulties in the investigation, and the diversities of opinion, arise from observers not seeing the beginning and the end. If the instance I have given of separation was *after* conjugation, it would show gemmation as a result, for a gemmule was developing itself. If, on the contrary, one of the separating bodies was already developed from gemmation, it would settle one question—viz., as to whether gemmation was indeed *one* result of conjugation? Nothing that I have seen written is at all satisfactory on this head, and my hope is in our numerous observers, and that there may be many present whose researches may throw light upon this interesting question.

The phenomena of gemmation and fission, as also of conjugation and of embryonic germs, if the ovate bodies I have mentioned come under that denomination, is witnessed in many organisms directly allied to the *Actinophrys Sol;* it would surely, then, be most unphilosophical to deny either of the phenomena to be a part of the life history of this organism.

Whilst upon the subject, I may mention that a writer in the Transaction of the Microscopic Society* (Mr. Boswell) has asserted that the power of suddenly taking a leap exists in the *Actinophryina.* I do not believe this can be said of the *Actinophrys Sol*, for out of hundreds of examples I have never witnessed a single act of rapid motion. But there are organisms so very similar in appearance, that may or may not be (I believe they are) classified under the Actinophryina. One of these I have figured, of a pearly grey colour, found in Swanscombe Marsh, having very short but much more numerous processes than the *Actinophrys Sol;* and this I have

* 1854, p. 25.

frequently seen to whisk out of the field with a rapidity like lightning, in this case using the processes as motive organs. I think I have also noticed this fact in one of a bright green colour, found at Hampstead, as well also in one of a grey tint found in the same locality. These have no contractile vesicle that I have seen ; they are not found in abundance as far as my experience goes, and their being classed with the Actinophrys Sol may be due only to their resemblance in shape. My belief is they are larval forms of other creatures.

Among my drawings of the 8th May, 1861, from the same gathering, was one very small object, white and transparent in substance, with tentacular processes like the actinophrys, of which it may have been an early stage. I exhibit a drawing of it, bearing its relative size to the other forms (Fig. 17). I have brought forward this subject now for two reasons—first, because this is the time of the year to pursue this investigation for those who may be interested in it; secondly, because I do not wish to be quite an idle member of the Club.

Plate X. Illustrates this Paper.

EXPLANATION OF PLATES,

ILLUSTRATING MR. F. KITTON'S PAPER.

Plate II.

Figs. 1 and 6, *Trinacria Regina*, side view; 2, outline of base (grund fladen); 3, outline of base (side view); 4, side view of frustule; 5 and 7, side views of valve.

Plate III.

Fig. 1, *Corinna elegans*, front view of frustules in series; 2 and 3, front view of valve; 4, transverse section of valve; 5, transverse side view of valve. 6 and 7, *Trinacria excavata*, side view of valve; 8, front view of valve; 9, front view of frustules in series. 10 and 15, *Solium exsculptum*, side views of valves; 11 and 13, front views of valves; 12, front views of frustules in series; 14, side view of valve, inner surface.

Plate XI.

Fig. 1, *Hemiaulus Proteus*, front view; 2, side view of valve, inner surface (grund fladen); 3, side view outer surface (Hoved fladen); 4, valve as seen edgewise (Iværsmittet); 5, front view of large valve; 6, front view of small valve. 7, *Hemiaulus hostilis*, front view; 8, front view of two opposite valves (small); 9, side view of valve, inner surface; 10, side view of valve, outer surface; 11, valve as seen edgewise. 12, *Hemiaulus februatus*, front view; 13, front view small valve; 14, side view, inner surface; 15, side view, outer surface; 16, valve as seen edgewise.

Diatomaceous Deposits from Jutland.

By F. Kitton.*

The remarkable deposits found in and near the island of Mors have lately attracted the attention of microscopists (principally through the introduction of the beautiful slides of Herr Müller, of Wedel, the preparer of the Typen Platte). This deposit, with perhaps one exception—the so-called "Bermuda Earth" (New Nottingham deposit)—is richer in bizarre and beautiful diatomaceous forms than any other hitherto discovered. The material best known in this country is that called "Cemenstein," from the island of Mors, a large island situated in the Liimfjord (lat. 56° 50′ N., long. 8° 40′ W.). This fjord, the most extensive in Jutland, runs from east to west, connecting the North Sea with the Kattegat. The Cementstein from Mors resembles a dark grey slate, interspersed with white veins. The silicious organisms of which it is chiefly composed are held together by a calcareous cement, and when submitted to the action of acids are slowly disintegrated with effervescence. A similar deposit occurs in Fuur; it is, however, more difficult to separate, and but slightly affected by acid, and resembles the deposit known as "brown coal." A third deposit is found in Nykjobing, a small town or village on the western side of Mors Island. This deposit is of a greyish white colour, still more difficult to reduce than the preceding, strong acids not affecting it in any appreciable degree, and only by the assistance of caustic potash or soda can the organisms of which it is composed be effectually separated. One of these deposits seems to have been known to Professor Quekett, as he figures a small Triceratium in his "Histology" (vol. ii., p. 74, fig. F), and which is apparently a small form of *Trinacria excavata*, similar to the variety found in the Nykjobing deposit; this, the Professor says, is from "Jutland slate."

Dr. Heiberg, in his "Kritisk oversigt over de Danske Diatomeer," describes a few of these deposit-forms, and also gives some excellent figures of them.

* Communicated by M. C. Cooke, M.A., June 24th, 1870.

Dr. Heiberg, in the above-mentioned work, proposes a new family, based on the genus Hemiaulus of Professor Ehrenberg, a genus well represented in the Barbadoes deposits. The species of this genus bear a superficial resemblance to the genus Biddulphia, but approach nearer to some forms hitherto considered as Triceratia. The following is Dr. Heiberg's synopsis of the family:—

HEMIAULIDÆ HEIBERG.

Frustules uniform, front and side views always symmetrical, nearly rectangular in front view, with long horn-like (hyanestillede) processes terminating in one or two straight or inclined spines, the processes straight on the outer margin, forming a right angle with the base of the valve (en ret Vinkel mid Skallens Grundflage). Sculpture consists of larger or smaller punctæ; variously arranged costæ are sometimes present; markings of connecting zone (Bindehinden) less conspicuous.

Tribus I.—*Hemiaulidæ genuinæ.*

Outline of side and front views symmetrical, both in longitudinal and transverse axes, or if more than two axes symmetrical with all of them.

Genus 1. *Hemiaulus.* Ehr.

Outline of valve elliptical (lanceolate oval), produced at the longer axes into horn-like processes, the points of which are provided with a spine (een Torn).

Genus 2. *Trinacria.* Heiberg.

Outline of valve with three* equal angles (with axes of equal value), front view of frustule with three horn-like processes, each terminating in two spines.

Genus 3. *Solium.* Heiberg.

Outline of valve regularly quadratic† or rhomboid, frustules in front view with horn-like processes at the corners, and terminating with two spines.

Tribus II.—*Hemiaulidæ cuneatæ.*

Outline of valve oval (ægdannet), front view wedge-shaped, frustule only symmetrical in the long diameter.

Genus 4. *Corinna.*

Outline of valve regularly oval, with two horn-like unequal

* This character of the Author must be enlarged if of any generic or specific value, as *Trinacria regina* occurs with four sides.

† The preceding remarks apply to this genus. In the Fuur material we find *Solium exsculptum* with five angles. For specimens of this form I am indebted to G. M. Brown, Esq., of Liverpool.

processes, of which the larger occurs at the broadest part of the frustule; both are armed with two spines.

Hemiaulus Proteus (Heiberg).—Frustules in series, cohering at the produced angles, each of which are armed with a stout curved spine; space between the angles with a large central inflation, and one or more smaller inflations on each side, decreasing as they approach the angles. Side view elliptic, lanceolate centre widely constricted, and four or more costæ (the costæ correspond with the depressions seen in front view); cellules scattered, distinct. (Cementstein Mors, brown deposit, Fuur. Pl. xi., fig. 1-6.)

Hemiaulus hostilis (Heiberg).—Frustules in series cohering at the angles; processes elongated, terminating in a slender, straight spine; one large central inflation between the angles; side view oval, with two costæ; cellules scattered, distinct, smaller, and closer in centre (between the costæ); Cementstein Mors, brown deposit, Fuur, rare in Nykjobing deposit (pl. xi., fig. 7-11.)

Hemiaulus februatus (Heiberg).—Frustules in series; processes terminating in a stout, curved spine; space between the processes, with a single inflation; bases of processes suddenly inclining towards the inflation; side view ovate; costæ, two; cellules large, moniliform, very conspicuous in the centre (between the costæ), in all the preceding deposits (pl. xi., fig. 12-16.)

Trinacria Regina (Heiberg).—Frustules in series cohering at the processes; processes produced hornlike at right angles to valve, tipped with two incurved spines; valves with three or more sides, slightly concave; outline slightly undulate; marking consisting of conspicuous pearl-like granules, distant and scattered near the smooth centre, but distinctly radiant as they approach the margin; common in the Cementstein Mors and Fuur deposit, scarce in the Nykjobing deposit (pl. ii., fig. 1 to 7).

Trinacria excavata (Heiberg).—Frustules in series; processes long, at right angles to valve, armed with two incurved spines; valves, with margins, deeply concave; granules distinct, radiating from the centre; Cementstein Mors brown deposit, Fuur; the small variety occurs in the Nykjobing deposit (pl. iii., fig. 6 to 9).

The small form (fig. 7) is probably identical with *Triceratium ligulatum* of Dr. Greville (Trans. Mic. Soc., vol. xii., pl. 13, fig. 9.) The larger form I have no hesitation in referring to *T. Solenoceros**

* Dr. Heiberg says in his Danske Diatomeer, "Kan jeg ikke antage Andet end at Brightwell har hav en fra nærværende Art faskjellig Form for sig" (page 51).

Eh., and *T. Kittonianum* Grev. (see Trans. Mic. Soc., vol xiii., page 1, pl. 2, fig. 18) ; a careful examination of the deposits in which Ehrenberg found his specimens has afforded me an opportunity of observing many valves perfect and fragmentary ; and I find the "pseudo-nodules" are more or less distinct in all of them. The differences between *T. Solenoceros* and *T. Kittonianum*, which Dr. Greville says are so very decided, are really of no specific value; the pseudo-nodules (processes as seen in side view) are not absent in *T. Solenoceros*, excepting in the figures in the Microgeologie and Mr. Brightwell's monograph of the Triceratia. I have examined Mr. Brightwell's slides, and although the processes are not very distinct, they may be detected. In the same paper Dr. Greville remarks that the pseudo-nodule is very conspicuous in *T. Kittonianum*, and he quotes my sketch of the front view, in which he says it "projects above and below the connecting zone like a hammer:" this character further identifies it with *Trinacria excavata.*

Solium exsculptum (Herberg).—Frustules in series cohering at the angles; processes at right angles to surface of valve tipped with two curved spines; space between the processes inflated; valves with four or more sides ; angles produced mammiform; costate at base ; cellules small, slightly radiant; Cementstein Mors, brown deposit, Fuur, Nykjobing deposit (pl. iii., fig. 10 to 15).

This remarkable form seems to bear the same relation to Amphitetras as Trinacria does to Triceratium ; in the Fuur deposit valves with five angles are not uncommon.

Corinna elegans (Heiberg).—Frustules wedge-shaped in series cohering at the angles ; processes two, unequally produced, armed with a short spine ; inner margin of process slightly undulated ; centre conspicuously inflated; valve ovate, apiculate; cellules small, radiant. Common in the Cementstein Mors, brown deposit, Fuur, Nykjobing deposit.

A very curious form, closely allied to Hemiaulus, from which, however, it is separated by the two unequal processes. The long process of one frustule is attached to the long process of the next frustule, and thus forming a curved filament. The *Hemiaulus pulvinatus* of Greville greatly resembles this species.

In a future paper I hope to describe some of the discoid and other forms occurring in these deposits.

Valedictory Address of the Retiring President,

P. Le Neve Foster, Esq., M.A., F.R.M.S.

(*Delivered July* 22, 1870.)

Gentlemen,—Five years ago, the Quekett Microscopical Club consisted of eleven members; it now numbers upwards of five hundred. At first we were looked upon somewhat coldly by our elder brethren, simply because our aims and objects were not understood, and because we were supposed to be antagonistic to existing institutions. When once, however, it was explained that we were not a revolutionary body, but were purely a band of earnest workers, desirous of extending the benefits of scientific combination to many who, from a variety of causes, could not or did not feel themselves sufficiently advanced in the study of microscopy to join in the gatherings of their elders, all suspicion vanished, and the hand of fellowship was cordially extended to us. Our success arose from two causes:—First, we represented a want; and, secondly, we were under the guidance of zealous and energetic helmsmen, who not only had the sagacity to lay down the right course for our newly-launched vessel, but kept her head steadily to it. Among these I must specially name our late Honorary Secretary, Mr. Bywater, for to his exertions mainly in our early years must our success be attributed. We all know, in these undertakings, how much depends upon the work of one man; with tact and skill he gathers around him the necessary elements for accomplishing the objects he has at heart. Mr. Bywater stuck to his post until the Club had become so great a success that he could hand it over in complete working order to his successor. While we regretted the loss of his services as Secretary, we rejoiced to retain him, for counsel and advice, as one of our Vice-Presidents; and it must be a source of gratification to Mr. Bywater to know that his labours on behalf of the Club have been thoroughly appreciated by all the members. The testimonial which was presented to him on his retirement was indeed well earned, and though I could not claim the privilege of presenting it, that duty properly falling to the lot of

my predecessor in this chair, under whose auspices it had been set afloat, yet it gave me unfeigned pleasure that one of the first public acts which took place after my election to the chair of this Society should have been of so agreeable a character. Gentlemen, while I thus speak of the success of the Club, and of the numbers which now swell the list of its members, we must not forget that numbers, though in some degree a test of success, are not everything; we must look to what we are doing in the way of promoting the science we are banded together to assist. Are we doing all we can, all we ought? I scarcely think that we are. I am disposed to think that we do not take sufficient advantage of our organisation. We are not sufficiently systematic in our proceedings. We must bear in mind that, however agreeable, and even useful, it may be to meet and gossip about this or that at our monthly and fortnightly meetings, and listen to a paper on some isolated point, that is not the end and object of our Society. We should remember that we are essentially a student body, and I could have wished at our meetings that there could have been more discussion to follow the reading of our papers. This want of discussion is evidence that the subject has not sufficient hold on the labours and investigations of others to call forth inquiry and debate. This, as I have said before, arises from a want of system in our proceedings. A paper on some special subject, or branch of a special subject, is brought before us without previous concert with others; it comes frequently before us without previous notice, possibly no one else has been pursuing the same or kindred train of investigation, and there is consequently no one capable of adding to the common stock of knowledge; the paper is too apt to fall dead, without interest, and obtains no further notice till it is read, or perhaps not read, some months afterwards in our Transactions.

The Club has no doubt accomplished great good in diffusing the taste for microscopical investigation, and in facilitating the communication of results, but room is still left for suggestions as to enlarging its usefulness. In the face of existing scientific societies, the grounds for establishing new ones are two-fold—first, affording other facilities for the acquisition of new truths; second, the extension of the cultivation of the particular science amongst persons not comprised in the elder society. Each body then should have its own characteristic, so as to ensure its occupying its

own special ground; otherwise the societies tend either to become rivals, whence a waste of scientific power, or pale reflexes of one another mutually deteriorative.

The Quekett is, as I have said before, a society of students, neither desiring to rival or reflect the Microscopical, but to supplement it. Looking over the papers, and listening to its meetings, it does not seem quite to possess the special character it might be desirable to impress on it. Many of the papers have quite sufficient integral merit to have been read at any society, but are not characteristic of ours. They touch on the usual topics in the usual manner. Of real students' papers there are very few, and I would appeal urgently to students for more.

Perhaps microscopical science, at present, is itself in some degree chargeable as a cause for this state of things. The modern tendency is rather to subordinate the ends to the means. The actual work done is decidedly below all proportion to either the quantity or quality of admirable instruments turned out by our best makers. But do we not, in testing and proving their admirable qualities, rather addict ourselves to those branches of investigation which test the power of the instrument more than the intelligence of the observer? Réaumur, or Leuwenhoek, or Swammerdam, or Tremblay, had nothing to compare with our ordinary commercial Birmingham instruments, much less with our best artists' work, but has our society collectively yet produced a tithe of the labours of one of these great men? As bearing on this, students cannot be too frequently reminded that facility of labouring with the simple microscope must precede all valuable study. The young microscopist is too apt to undervalue the resources of this instrument. Again, few remember how important, how essential, are those two powers, to dissect and to draw; nothing can replace or compensate for them, and yet how many who profess and call themselves microscopists can do neither.

Every naturalist knows the immense amount of detail which the study of any given organism reveals. Lyonnet's marvellous monogram on the caterpillar of the goat moth is a case in point; but few microscopists in the Quekett Club addict themselves to one subject of study—not that it is therefore to be counselled that no illustrative demonstrations should be taken. Nature is a whole; every part has relation to every other; but the microscopical student will do well to adopt a line of study, a single branch of inquiry, and let that be the thread on which to string his subsidiary

matter. For example, to study the nervous system first in a single insect through all its metamorphoses, paying special attention to the nerves serving special organs, antennæ, secreting glands, strings, ovipositors, then following the modifications into allied genera, and subsequently tracing them into other orders. Such an inquiry would occupy a very wide area and produce valuable results, and the student feeling their fertility and interdependency, would be stimulated to continue to mount and preserve his dissections, to register his observations, and thus accumulate knowledge. The amount of valuable information lost for want of systematic registration is surprising; no man will record isolated facts without *enchainement*, and if he did, he could make no use of them.

Few microscopists seem to be aware of the unreclaimed territory spread out for their investigation, in the comparative anatomy of special organs, whether of plants or animals. The fertilisation of cryptogams has been a good deal discussed; but how their reproductive organs are related, and how and why they have been modified, very little. Every microscopist knows the general character of cellular tissue, but how many know the comparative character of the tissue in different plants, and mode of modification?

Again, the phenomena of fermentation, so ably treated by Pasteur, in a chemical point of view, offer a grand field for microscopic investigation. The relation of this subject to health and disease will bear a vast deal more of discussion than has hitherto been accorded to it. The mysterious relations of life to matter may receive some elucidation from carefully conducted microscopic research. A more noble field for the exercise of the human intellect can scarcely be imagined.

And this gives occasion to suggest some points for rendering our instrumental strength more available for research, by means of collaboration—a principle of action more frequently in force abroad than at home.

There are many microscopists with means at their disposal, and magnificent instruments, who have no leisure for collection, nor skill in drawing and dissection; there are young and active members of the Quekett with leisure and skill, and small means. Now, let us suppose a member fortunately blessed with a complete instrumental outfit, associating himself with two or three active young men, one a good dissecter, a second a skilful draughtsman, and a third an industrious collector, and imagine these addressing their talents to the cultivation of one of the lines of research above

pointed out, how valuable to us would be their combined labours, and what a characteristic volume would our transactions become.

There is another field for labour, comparatively uncultivated, available for those who may have neither of the enumerated qualifications—the abstraction and reduction of the vast mass of British and foreign literature bearing on our subject-matter. Before a student begins a line of inquiry, he wants to know what has been done; for example—who has investigated the functions and structure of the antennæ of insects? That inquiry alone would occupy weeks, and would lead him through an enormous mass of irrelevant matter, scattered through general and special treatises, monographs, reports, and transactions of innumerable societies. The Quekett could well spare an occasional evening to hear the summarised results of an examination, pursued through these sources, into any branch of special study; and the historical enumeration of previous labours often supplies a valuable stimulus to further investigation.

Again, permit me to urge on our younger members the importance of mastering the principles on which our instrument is constructed, for, believe me (although I am well aware we have able and skilful microscopists who do not possess this knowledge), it will tend much to a true interpretation of what the microscope discloses if we have some knowledge of the optical principles on which it acts. I question if there are many in this room, skilful as they may be in the manipulations of the instrument, who have any clear conception of the principles on which the achromatism is produced, and fewer still who know anything whatever of the laws regulating the phenomena of polarisation. The study of optics, both physical and geometrical, is well worthy the attention of every microscopist, for unless he has mastered these, he is dependent in a great degree upon rules and methods, to him more or less empirical, for the use of his instrument, and the interpretation of what it presents to his eye. Many a fallacy which now passes unheeded might be detected if he knew the principles upon which the representation of the object was brought to his view. What insight might be obtained into the internal and molecular structure of objects, if the observer knew thoroughly the properties of polarized light, instead of relying simply on certain empirical rules, and unable to interpret the exceptions. The rules alone might lead him astray, whilst a power of discriminating the exceptions, which a knowledge of principles would give him, might carry him on to further researches and

ultimate discovery. It is singular that, while astronomical science has kept ahead of her instruments, and has always been pushing forward the opticians to meet the wants of the astronomer, in microscopic science the contrary would seem to be the case. Our opticians here have gone ahead of the observers, and I think it may fairly be said that microscopic science has not advanced in discovery proportionately to the means which optical science has placed at its command. How far this is attributable to the neglect of optical science on the part of our observers may be disputed, but I cannot help thinking it may have something to do with it. While I am advocating the study of optics, let me not be supposed to confine my suggestions to optics alone; indeed, they cannot be studied with any degree of profit unless in connection with other branches of physics. Every day is bringing each branch of science more and more into relation with the others; in studying one, the principles on which it is based are found applicable, more or less, to all. And here let me say a word on behalf of mathematics as an adjunct to these studies. It is the fashion now-a-days to throw reproaches on the study of mathematics as useless in the study of physics, but, I venture to think, very undeservedly; for although there has been hitherto in our universities a neglect of experimental physics, and too exclusive a teaching of natural philosophy by means of mathematics only, I hold that the union of the two is essential for the thorough investigation of physical science. Let the student get a true conception of the principles which experiment will give him, and he will find, in mathematical language and methods, a means for expression of thought, which will more readily enable him to pursue his investigations than if left to unaided reasoning alone.

Our instruments are marvels of optical power. We have gone on from the 1-4th to the 1-8th, the 1-8th to the 1-12th, from 1-12th to a 1-25th, and even to a 1-50th. The opticians have placed at our command powerful means of research, and what account can we give of the talent committed to our charge? I fear the answer is not one of which we can be proud. Look at the means in the hands of our early microscopists, and note what they did, and how much they accomplished with far inferior means and appliances. I fear we are too apt to pride ourselves as being the possessors of superior instruments; each man pits his microscope in rivalry against his neighbour's, and rejoices that he can beat him in the resolution of Nobert's test lines. There, unfortunately, the rivalry too frequently ends. The difficulty in this matter no doubt is, that our young men,

ardent and energetic as they are, rarely have had that early training in the elements of science which fits them for taking up any special line of research. The young microscopist finds himself at starting confronted by difficulties in the pursuit of any special investigation, frequently arising from the want of that mere elementary knowledge in science, which might readily have been imparted to him at school, but which, alas! has been totally neglected. He has the tools, the tools of marvellous power, and he is incapable of turning them to account, because he knows nothing whatever of the elements of any science in which he ardently desires to commence a research, and finds that he must pass through the drudgery of these elements ere he can start on his career of investigation. He is thus disheartened, and his instrument too often remains in his hands, simply a splendid toy. Happily these times are passing away—the days of exclusive classical teaching are numbered. Science is gradually making its way into our schools, and I trust that the coming generation will go forth into the world better prepared for promoting the progress of science, and its application to the material interests of mankind. Improved education lies at the root of all our progress. This, however, is not the place to enter on the educational question, though, necessarily, associations like ours feel a deep interest in it, and are largely affected by it in their influence for good. While, however, I have been pointing out what, in my opinion, the Quekett may do more than it already has done, I wish clearly to be understood as in no way expressing a censure on its proceedings; on the contrary, it has already done much if it has only fostered a taste for microscopic research, and cheered on the student to pursue a career which, unaided, would have led to nothing; and if any words which I have dropped this evening can in any way promote its usefulness, my object has been attained. The club was prosperous when I had the honour of being elected to preside over it, and it is a source of pleasure and pride to me that, thanks to the able assistance of my colleagues in the Council, to whom all the merit is due, I hand it over to my successor in a no less efficient condition than it was entrusted to me. Gentlemen, I thank you for the kindness with which I have at all times been treated when I have come among you, and for the very friendly assistance which every one has so fully given me in my year of office. Wishing the club a prosperous and successful career, I take my leave.

The Pencil-tail. (Polyxenus Lagurus.)

By S. J. McIntire, F.R.M.S.

Pencil-tails inhabit the bark of the willow, the elm, and the apple-tree. Occasionally they may be seen wandering in a solitary manner, but generally they are to be found in colonies numbering four or five, and very often as many as thirty. When the colony is this size there is generally in its immediate neighbourhood a web which may be spun by the Polyxeni, but it may be the deserted home of some spider. Although there is strong suspicion that the former suggestion is probable, it is by no means proved, and I would rather wait till the pencil-tails have been detected in the act of spinning it, before endorsing the strongly asserted opinions of a certain friend of mine on this point.

I have kept them alive for various periods of time during the past five or six years, and they have proved a source of much pleasure to myself and others. Their beauty is remarkable, but they do not display much intelligence. At various times from the middle of April to July, I have been gratified by finding they had deposited eggs, but I am sorry to say that I was not successful in the attempt to hatch and rear the young. The eggs have always been in small groups of about one dozen, white, oval, and imbedded in a quantity of hair, which is easily recognized as having been obtained from the creature's tail. The single hairs are most carefully interlaced with each other and round the eggs, and the whole forms a beautiful object not unlike a miniature bird's-nest containing eggs. Dr. Gray first called my attention to the depositing of eggs in a cell I gave him some two years since, and a day or two afterwards my own specimens fabricated similar nests. Our secretary, Mr. White, has the satisfaction of being the first to witness the hatching out of the young; this happened to him a few days ago, and he kindly permits me to quote portions of his letter intimating the success of his experiments.

"The number of eggs seems to be irregular, about nine being

laid in one nest, four in another, and five or six in another; for some few days or so before they are hatched the embryo can be seen through the walls of the egg, and the eyes are reddish, five in number, and arranged in a slight double curve. When born they have three pairs of legs, they are almost white when they first emerge, but soon become tinted a pale drabbish-yellow. The period of incubation seems to be about six weeks, because my first eggs, laid on June 1st, hatched yesterday; some laid a day after are hatching to-day, while some eggs laid later are only showing signs of hatching." (12th July.)

I once thought February was the best time for collecting Polyxeni, but I have since ascertained that they may be obtained in various stages all through the year. These stages are indicated by the number of feet which the pencil-tails possess. It would appear that three pairs of feet is the minimum number, and 13 pairs the maximum. This latter number indicates the adult condition which is attained by successive moultings. I have had at one time in the same cell individuals possessing four, six, eight, ten, and thirteen pairs of feet respectively. The cast skins, representing the progressive development of the Polyxeni, are to be found in abundance in the neighbourhood of their home, and, if carefully collected and mounted, form interesting and beautiful microscopic objects. Excepting in the number of segments, which is variable for the reasons above stated, there is no difference between the exterior ornamentation of one pencil-tail and that of another; they are all equally beautiful.*

The dorsal aspect exhibits curious scales, each of which is a study in itself, in transverse double rows. In the adult condition there are ten of these rows, and the sides of nine of the segments which are thus ornamented by these appendages are still further graced by bushy tufts of erect scales of somewhat different, though analogous structure. I think also, that the dorsal rows of scales are erectile at the will of their owner.

Viewed with the dorsal aspect next the eye, no feet are visible the little pencil-tail glides along the field of view while the observer wonders how it makes progress, and is charmed with the harmonious blending of colour, especially if it be on a piece of its native bark, stained with fungi-spores of various colours. The skin is

* Especially beautiful are they for some six hours or so after a moult.

yellowish-grey, with three brown bands extending from head to tail; the scales are of leaden hue, and curiously sculptured; while the double bunch of hairs at the caudal extremity glistens like frosted silver or driven snow.*

The head is abundantly furnished with fantastic rows of erect scales, among which the antennæ may be seen rapidly vibrating, and occasionally the strange-looking little groups of simple eyes, situated at the sides of the head, appear for an instant and then are obscured. Bye-and-bye the pencil-tail, which seems to love darkness rather than light, exposes its ventral surface to the bright beam of light we have cast upon it, by climbing upon the cover of the cell, and the aspect now is quite as bizarre as that I have endeavoured most ineffectually to describe. Such a regular array of many-jointed feet ending in sharp claws, all in motion; such a curious mouth; the integument of the belly folding into rhombs and triangles as it moves; but there! I know my listeners will endeavour to see this little creature for themselves, so I need not expatiate further in this fragmentary educational sketch.

Should any one be induced to study the anatomy beyond the points I bring forward now, and let us hear the results of his observations, we shall all be the better for it, and my object will be attained. In order to assist such enquirers, I have searched for and collected the following notes respecting the Myriapoda :—

Until 1867 only two orders were recognised in the group of Myriapods—viz., the Chilopods and the Diplopods. The former are all "active and carnivorous," and the latter "sluggish vegetarians." So says Sir John Lubbock in his paper in the Linnean Transactions, on Pauropus, a creature possessing so much in common with each of these orders, and yet so much distinctive, that its claim to be considered as the representative of a third order of Myriapods is now, I think, undisputed. I quote a few of his remarks :—

"*Chilopods.*—Antennæ 14-jointed at least; one pair of legs modified into powerful jaw-feet; generative organs opening at the posterior extremity of the body; legs in single pairs.

"*Diplopods.*—Antennæ with not more than seven segments; no jaw-feet; apertures of the generative organs in the anterior part of the body; legs, after the first six, arranged in double pairs."

* These hairs are figured in Carpenter as "Hair of Myriapod."

Examples of the ferocious Chilopoda are to be found in the various descriptions of centipedes; and of the vegetarian Diplopoda in the various "pill-millepedes" (or, as some call them, "wood-lice"), the Julidæ (or wire-worms of the farmer), and our little friend Polyxenus.

In common with the whole group, the Polyxenus breathes by means of an extensive tracheal system. Its eyes are, I believe, ten—in two groups of five in each. There are, however, on each side of the head two objects, whose character I have not satisfactorily determined ; if they are eyes, the total number is fourteen. The antennæ are, I believe, 8-jointed, although authorities declare seven segments in these organs is the maximum number existing in any of the Diplopods. It would appear that the Polyxenus is one of the connecting links between the Myriapoda and the Annelids ; its nearest congener in that group being Nereis, one of the marine worms.

These points, and many more bearing upon the subject, which I need not dilate upon, are detailed in the paper I have alluded to (Transactions of Linnean Society, Vol. xxvi.), and I recommend those interested to read it.*

A casual allusion is made in "Wood's Natural History" (Routledge) to Polyxenus. He says (Vol. iii., p. 696) that "it is found under the bark of trees, in clefts of walls, and in moss." Dr. Gray and myself found a couple under a stone at the foot of a tree near Mickleham on June 24th of this year, but this was quite an exceptional case in my experience. I never before obtained any elsewhere than on willow, apple, and elm trees, and I therefore think the two specimens I allude to must have been, like so many members of the Quekett Club on that day, out for an excursion when we caught them. Strangely enough, too, under the same stone there was a larva of Tiresias Serra, a well-known friend to some of our members, owing to the ventilation of the "Hair of Dermestes" question. I have often noticed the association of these two creatures, and guessed the reason why. The Tiresias larva is carnivorous, and the Polyxenus vegetarian. Does the Tiresias feed upon Polyxeni ? I must leave that question for the solution of enquiring observers. In "Science Gossip" (Vol. i. p. 230) a figure

* In another paper, by the same author, "On the generative organs and formation of the egg of the Annulosa" (Philosophical Transactions, 1861, page 595), there is a vast amount of information also.

of each, accompanying my short paper, will be found. The association of the two, even then (1864-5), often attracted my attention.

Dr. Gray has since told me the further adventures of these three captives. They were all put into a cell together, and for a time all went well, but within the last few days the Tiresias larva has cast his skin and come out quite smart, whilst one of the pencil-tails has died. Not only died, however, for every vestige of him has disappeared. I need hardly say that strong suspicion of foul play rests on the character of that Tiresias larva in this matter.

The compendium of Generic Distinctions at the end of "Wood's Natural History" (Vol. iii.) contains much information respecting the Myriapoda, put in a convenient form for study.

There is also some information, very good, but at the same time very scanty, to be obtained in the "Micrographia Dictionary," under the head "Myriapoda."

I think I have now put before you as briefly as I could the most valuable of the information I have been able to obtain, and it only remains to me, after thanking Dr. Gray and Mr. T. C. White for many hints, and Mr. Ward and Mr. Blatch for specimens which they have kindly furnished me with, to indicate the method of capture and keeping of the pencil-tails which has been found most successful. Having discovered the objects of our search in the localities I have pointed out, or in other new ones, a camel's hair pencil and a test tube are indispensable to effect the removal of the pencil-tails from their homes uninjured.

Then, or as soon afterwards as possible, our tubes must be emptied into cork cells such as I have described on a former occasion. It will be well to introduce as food a small fragment of the bark also, and if it is kept damp they will often be seen feeding upon it. So, too, will they feed upon the blotting paper of the cell, and on one occasion a healthy colony I had succeeded in capturing burrowed their way through it and escaped, to die, I fear.

Plate XII. illustrates this Paper, and contains a magnified view of the under-side of the insect, the hairs and scales, and a cluster of eggs.

Chislehurst Excursion, May 28, 1870.

In a search among the nettles in the vicinity of the Railway station I obtained a fly, to the abdomen of which were attached three parasites. The fly was a small Psychoda, one of those curious small flies with broad deflexed hairy wings, and long antennæ, composed of globular verticillated joints, often found on windows, and said to reside, while in the larva state, in dung; and the parasites were acari, nearly allied to the parasites common on the humble bee—a species of Gamasus in fact. Though the fly, when put into a collecting tube, ran about actively, I doubt not it was much inconvenienced by its triple burden (which to the naked eye appeared as if the fly's abdomen were red), for on my arrival at home, I found it had succumbed, though the parasites still remained in position. I, therefore, shook it out of the tube, and dropped some benzine upon it immediately it had fallen upon the glass-slip. This of course killed the parasites ere they had time to escape, and was preliminary to further applications of benzine and balsam. The final result was moderately successful: the fly and its parasites form a slide in my cabinet.

The Curculionidæ obtained were not numerous, it being rather early for them, yet such as we did find were of great beauty. As about 400 species are known to be inhabitants of this country, it is a matter of difficulty to be certain as to the names. Westwood, however, says that "the Polydrusi and Phyllobii" are not less beautiful than the Diamond Beetles of the Tropics, though of smaller size than they; and this is all the authority I have for considering the brilliant green or red beetles found on this occasion to belong to this genera. The same authority says that the larvæ of these beetles are more or less like the fleshy grub which we often find in the inside of nuts, and that they are vegetable feeders in all stages of their existence. I believe all that we found on this occasion feed on herbaceous plants, especially the nettle, and the foliage or soft twigs of the oak and the beech trees.

A little earlier in the season I noticed, on Wimbledon Common, a small species in the perfect condition feeding on the blossoms of the furze, which were punctured with minute holes just large enough to introduce a pin. The brilliantly-coloured species of Curculionidæ are always best mounted in balsam, but the more homely-coloured ones (those found on the nettles all through the summer, which claim notice rather from their curious shapes than their scaly coating) are perhaps best mounted *dry*.

In collecting these beetles one soon observes their habit, as soon as they are alarmed, of loosening their hold of the stem or leaf upon which they were walking, and dropping to earth. A knowledge of this fact enables the collector to circumvent them in their artifice to escape from danger, by placing his trap, consisting of, it may be, an umbrella, or, as happened on this occasion an obliging friend, underneath the branch, which was then shaken ; of course the beetles and various other insects fell on to his shoulders and back, whence ingenious Queketters, never at their wits' ends, transferred them to their bottles and boxes.

Numerous small flies were obtained, respecting which I am unable to offer any observations. I may, perhaps, however, be permitted to mention a plan of preparation of such tiny insects, which has lately found favour with me. It is to kill the insects in benzine, and let them soak there until the spirit has thoroughly permeated them. Then mount them in cold fluid balsam, and wait patiently for it to set. The drawbacks of the process are that oftentimes the less are not in desirable position, and there is much opacity ; but the advantages, which to my mind counterbalances these, are that the specimens are not damaged to the extent that often is the case by the use of liquor potassac ; and under reflected light the natural colours are not hidden or changed.

Of the Thysanura, numerous specimens of the genus Smynthurus were obtained ; some of them were of purple colour on the dorsal surface, and others yellow. These latter were probably Smynthurus Aureus. They are very curious little creatures ; so curious, indeed, that were they better known they would be much sought after. As well as the surface of stagnant pools, they inhabit grass, and nettle banks, and considerable numbers of them fall to the bottom of the net which is used to sweep these localities. From thence they must be swept into collecting tubes with a light jerk of a camel's hair pencil if we desire to capture them.

Although relatives of the scale-bearing poduræ, their affinity with them is not at first sight apparent. Their bodies are of oval shape, and their heads, which bear long four-jointed antennæ, are very large in proportion. The eyes are situated just behind the antennæ, in two groups of eight in each. They possess a long forked caudal appendage or springer, but one of their most curious features is the ventcal tube, whence they are able to protrude two long filaments or tentacles to an extraordinary distance. In this manner they appear to be able to reach the greater portion of the surface of their bodies, and it may be, to lubricate it freely by means of them. Nicolet, quoted by Sir John Lubbock, says of these tentacles that they are gifted with a retractile movement exactly like that of the tentacular eyes of the slugs. A short time ago a friend of mine in the country was looking at a number of Smynthuridæ he had captured. Presently one which was presenting its dorsal aspect to the microscope, suddenly extended these filaments, and wriggled them round its shoulders, and then as suddenly withdrew them. The surprised observer was not prepared for such a performance, and immediately wrote me a long letter for an explanation, which fortunately Sir John Lubbock's papers in the Linnean Society's Transactions enabled me to give him. The first time I saw the performance myself I was equally astonished.

S. J. McIntire.

MR. SUFFOLK'S LECTURES.

"Microscopic Manipulation, being the subject matter of a course of Lectures delivered before the Quekett Microscopical Club, January to April, 1869, by W. T. Suffolk, F.R.M.S.,"* will explain itself what this volume contains. Mr. Suffolk's practical demonstrations on "Manipulation," given for two or three successive winters to members of the Club, are so well and gratefully remembered by those who availed themselves of the privilege of attending them, that they will welcome the present volume, and recognise in it the face of an old friend. The seven chapters of the book are devoted to Construction of Microscope—Mechanical Processes—Mounting Objects Dry and in Balsam—Mounting Objects in Fluid—Illuminating Apparatus—Polarised Light—and Drawing and Micrometry. These are illustrated with forty-nine engravings and seven lithographs. The volume is neatly got up, and we presume that only this announcement is needed to induce every member at once to purchase a copy for himself, not only for its own intrinsic value, but also in recognition of Mr. Suffolk's valuable gratuitous services for the benefit of the Club.

* London. Henry Gillman, Boy Court, Ludgate Hill.

PROCEEDINGS.

June 24th, 1870—*Chairman*, Dr. R. Braithwaite, F.L.S., V.P.

The following donations were announced :—

"Science Gossip"	from the Publisher.
"Land and Water" (weekly)	the Editor.
"The American Naturalist"	in Exchange.
"Transactions and Proceedings of the Edinburgh Botanical Society"	in Exchange.
Dr. Carpenter's "Principles of Human Physiology"	Mr. John Michels.
Suffolk's "Microscopical Manipulation"	The Author.
50 Slides	Mr. M. C. Cooke.
Also, for distribution amongst the members, a number of Packets of Washings from the Lambeth Whiteing Works, containing Spicula, Foraminifera, &c.	Mr. Archer.
Copies of "Chambre noir et le Microscope Photo-micrographie Practique," by Monsieur Jules Gerard	

The thanks of the Club were voted to the donors.

The following gentlemen were balloted for and duly elected members of the Club :—Dr. Lionel S. Beale, F.R.S., &c., Mr. A. E. Birch, Mr. W. J. Brown, Mr. Samuel J. Hawkins, Dr. Henry G. Knaggs, F.L.S., Mr. Wm. N. Lockington, Mr. F. W. H. Preston, Mr. William Smith, Mr. Ernest Swaine.

Mr. M. C. Cooke read a communication from Mr. F. Kitton, of Norwich, "On the Diatoms of the Morz Deposit of Jutland."

The thanks of the meeting were returned to Mr. Kitton for his paper.

Mr. M. C. Cooke also read an extract from the letter of a New York correspondent, stating that at a recent meeting there had been exhibited there a specimen of *Pleurosigma angulatum*, magnified 98,000 diameters, with plenty of light and clear definition. The extent of this amplification might be judged from the fact that the diameter of the field just included 4½ spherules, and 15 of them covered the circular field of view. It was the finest exhibition of the kind which the writer had yet seen. The exhibitor on the occasion was Mr. Dickinson; the object-glass 1-30th inch, by Wales, with No. 13 eye-piece, excellent illumination being obtained by one of Abram's condensers.

The Chairman said that a proposition had been made by Mr. Ross, which he had been requested to communicate to the meeting. It was that at the ap-

proaching anniversary meeting every member should make some present, no matter how small, to the Club. Mr. Ross would himself be happy to make a present of some books, which he had looked out for the purpose. The Chairman expressed his own approval of the proposal, and cordially recommended it to the consideration of the members.

The Secretary very highly approved of the suggestion of Mr. Ross. No doubt during the year every member had been working at some special object, and had prepared slides of it, which would make most acceptable and valuable additions to the Cabinet. One gentleman, Mr. Michels, a newly-elected member, had that evening presented to the library a copy of Dr. Carpenter's "Principles of Human Physiology," intimating that he did not know whether it was the kind of book that was wanted. Now no books could be more acceptable than works on physiology, the study of which could not be properly carried on without the constant use of the misroscope. Members were strongly recommended to give attention to the interesting subject of cell structure, using the ammoniacal solution of carmine for bringing out its beauties whilst under examination.

The Chairman announced that in accordance with the bye-laws all the officers of the Club to be elected at the ensuing annual meeting must be nominated at the present meeting. There were four vacancies on the Committee, caused by the retirement by rotation of Messrs. Arnold, Burr, Gay, and Slade, who were, however, eligible for re-election. The President and four Vice-Presidents had also to be elected. For the office of President, he had great pleasure in being able to announce that Dr. Lionel Beale, F.R.S., had kindly consented to allow himself to be nominated, and had promised, if elected, to attend and take the chair at the meetings as frequently as possible.

This announcement was received with applause.

The Chairman then invited members present to nominate gentlemen to fill the four vacancies as Vice-Presidents, intimating that six could be placed on the list in nomination, from which number four would be elected by ballot at the Annual Meeting.

The following gentlemen were then nominated as Vice-Presidents:—

Mr. A. E. Durham,	proposed by	Mr. Bywater,	seconded by	Dr. Matthews.
Mr. Henry Lee,	,,	Mr. M. C. Cooke,	,,	Mr. Hayward.
Dr. Braithwaite,	,,	Mr. Jaques,	,,	Mr. Arnold.
Mr. Arnold,	,,	Dr. Gray,	,,	Dr. Matthews.
Mr. P. Le Neve Foster,	,,	Dr. Matthews,	,,	Mr. Bockett.
Mr. Gay,	,,	Mr. White,	,,	Mr. Hailes.

The Chairman then intimated that nominations of gentlemen to fill four vacancies upon the Committee had next to be made. In this case also six names could be placed upon the balloting papers, from which the selection would be made.

The following gentlemen were then nominated as members of Committee:—

Mr. Allbon,	proposed by	Mr. Curties,	seconded by	Mr. Marks.
Mr. Golding,	,,	Mr. McIntire	,,	Mr. Hailes.
Mr. C. F. White	,,	Mr. Ruffle,	,,	Mr. T. C. White
Mr. Loy,	,,	Dr. Gray,	,,	Mr. Reeves.
Mr. Burr,	,,	Mr. Bywater,	,,	Mr. M. C. Cooke.
Mr. Bywater,	,,	Mr. Johnson,	,,	Mr. Hailes.
Mr. Slade,	,,	Mr. Garnham,	,,	Mr. Quick.
Mr. Marks,	,,	Dr. Matthews,	,,	Mr. Hailes.

Eight gentlemen having thus been proposed, the Chairman proceeded to decide by show of hands which two names should be removed from the list, and Messrs. Marks and Slade being declared in the minority, their names were accordingly struck out.

The following recommendations by the Committee were also announced by the Chairman—That Mr. Robert Hardwicke be appointed as Treasurer for the ensuing year, Mr. T. C. White as Hon. Secretary, and Mr. M. C. Cooke as Hon. Secretary for Foreign Correspondence.

The election of Auditors of the accounts for the year then took place, and Mr. W. T. Suffolk having been appointed Auditor on behalf of the Committee, the members were requested by the Chairman to elect an auditor on behalf of themselves. Mr. Oxley was thereupon proposed by Mr. Hainworth, seconded by Mr. Jaques, and duly elected by show of hands.

Dr. Matthews called the attention of the meeting to a further improvement in his turn-table. When he described his arrangement for holding the slide at the last meeting, he thought that he had arrived at the *ne plus ultra* in turn-tables ; there was, however, no such thing as perfection. Since that meeting Mr. Edward Hislop had discovered that we might dispense with the wedge entirely, by making the jaws of hard brass, with their surfaces curved. Enough spring was thus obtained to hold a slide firmly, and this alteration really seemed to have reduced the instrument to its very simplest form.

The Secretary announced that Mr. Golding had prepared a number of sections of rush for distribution amongst such members as wished to have them and were provided with bottles. The meetings and field excursions of the ensuing month were also announced, and it was stated that at the next ordinary meeting Mr. S. J. McIntire would read a paper " On the Collections at one of the Excursions of the Club."

The proceedings terminated with the usual conversazione, at which the following objects were exhibited :—

Batrachospermum	by Mr. Golding.
Section of Tooth of Pike (Polarized)	by Mr. Oxley.
Nest of Polyxenus Lagurus, made of its own hair...	by Mr. S. J. McIntire.

ANNUAL MEETING.

July 22nd, 1870.—P. Le Neve Foster, Esq., M.A., President.

The Secretary read the reports of the Committee, the Treasurer, and the Librarian.

The President moved, "That the reports now read be received and adopted."

Dr. R. Braithwaite seconded the motion, which was carried unanimously.

Mr. Lampray observed that there was a striking disproportion between the number of members and the amount of subscriptions received, and he inquired if this were due the number of subscriptions in arrear?

The Treasurer replied that such was the case ; he had himself used due diligence to get the amounts paid, but as the subscription was too small to employ

a paid collector, the matter had, for the most part, to be left to the members themselves to pay promptly.

Mr. Lampray said that the same thing had occurred to him at the last annual meeting, but it appeared there were a larger number of arrears this year. He thought this ought not to be so.

The Treasurer remarked that if some member would kindly make a proposition to bring defaulters to book, he himself at all events would be very glad.

Mr. Lampray inquired if those members, whose subscriptions were in arrear, continued to be supplied with the journal.

The Secretary informed Mr. Lampray that they had lately got rid of a great many defaulters; both he and the Treasurer had, in accordance with the bye-law, made written applications for payment, and no responses being received, the names were struck off the list.

The President, previous to his retirement from the chair, read an address, which was listened to with marked attention, and closed amidst loud and prolonged applause.

Mr. M. C. Cooke said he rose to propose a resolution to the club which, after the admirable address they had just heard, needed no remark from him. He rose to propose the thanks of the club to their worthy President for his services during his year of office, and for his admirable address that evening.

Dr. R. Braithwaite seconded the motion, which, on being put to the meeting by Mr. M. C. Cooke, was carried by acclamation.

The President returned his thanks to the club for the kind manner in which the vote of thanks had been proposed and received; he was only sorry that he had not been able to attend the meetings more often; he had, however, done so as often as was possible, and it had been a source of great pleasure to him to do so.

Mr. W. J. Brown and Mr. Quick having been appointed scrutineers, proceeded to distribute and collect the balloting papers for the election of officers for the ensuing year; meanwhile,

Mr. S. J. McIntire read a paper "On the Pencil Tail (Polyxenus Lagurus)," which he illustrated by a series of pencil drawings.

Mr. T. C. White said that he had been named in the paper as having been successful in hatching some Polyxeni. Mr. McIntire said some time ago that the eggs laid in his cells had dried up; thinking, therefore, that more moisture might be necessary, he had himself kept his own cells constantly damp, and also placed them in the sun. Some remarks which he had read as to the influence of light upon germination, led him to do this, so he kept the damp cell containing the eggs upon the window sill in the sun, and they hatched there in six weeks. When first hatched the young had only three pairs of legs, and it would be interesting to note how many additional pairs were added at each successive moult.

A cordial vote of thanks was then proposed by the Chairman to Mr. McIntire for his paper, and carried unanimously.

Mr. Burgess intimated to the meeting that he had brought with him for distribution a quantity of acari from Mexico; he did not know whether they might prove to be new forms. A friend of his (a member of the club) had in his warehouse a large number of bags of cochineal, and observing that not only the bags but also the floor of the warehouse had become covered with a large quantity of white dust, he took some home, and on examination, found it to consist of insects, most of which were covered with hairs, and there appeared to be

several varieties of them. He had with him a supply of these insects, and should be most happy to distribute them amongst such members as were interested about them.

Mr. W. H. Golding made some suggestions to the meeting relative to the desirability of giving the members free access to the library and cabinets at all the meetings of the club, and to the arrangements necessary for so doing, and after a few observations upon the subject from Mr. M. C. Cooke and the President, the matter was considered as one to be dealt with by the Committee, and it was referred to them as a recommendation.

The result of the ballot having been handed in by the scrutineers, the following gentlemen were declared by the President to be duly elected:—

As President................................	Dr. Lionel S. Beale, F.R.S., &c.
As Vice-Presidents	Dr. R. Braithwaite, F.L.S., &c. Arthur E. Durham, F.L.S., &c. Henry Lee, F.L S., &c. P. Le Neve Foster, M.A.
As Members of Committee	Mr. Allbon, F.R.M.S. Mr. T. W. Burr, F.R.A.S., &c. Mr. W. M. Bywater, F.R.M.S. Mr Charles F. White.
As Treasurer................................	Mr. R. Hardwicke.
As Hon. Secretary	Mr. T. C. White.
As Hon. Secretary for Foreign Correspondence..............................	Mr. M. C. Cooke, M.A.

The President then formally left the chair, and installed his successor, who was greeted with considerable applause.

Dr. Lionel S. Beale, on taking his seat, begged leave to thank the members of the club very heartily for the honour which they had conferred upon him in electing him as their President, and expressed the great pleasure which it would afford him to come amongst them. For the last sixteen years he had been actively employed in lecturing and otherwise, the consequence of which was that his work had been very much restricted to particular subjects. In his early days there was no Quekett Club, and as it was his fate to be early placed in a position of some public importance, it was necessary that he should concentrate his attention, perhaps even more than Mr. Foster would have recommended, and the consequence was that he was terribly ignorant of other subjects. He had listened with the greatest pleasure to Mr. Foster's address, and could endorse every word of it; it had also given him great pleasure to listen to the interesting paper of Mr. McIntire, the result of which would, no doubt, be that before long a great many cells of these little Polyxeni would be in the hands of members, for this was a club of workers, and had for its founder one of the most earnest workers which science had ever seen.

The following donations to the club were announced:—

"Land and Water" (Weekly)	from the Editor.
"Science Gossip"	the Publisher.
"The Monthly Microscopical Journal"	the Publisher.
"The Popular Science Review"	the Publisher.
"The American Naturalist," and the "Proceedings of the Birmingham Natural History Society"	In exchange for the Journal of the Club.
Eley's "Geology of the Garden"	from Mr. Bockett.
"The Microscope Made Easy," 1742	Mr. T. C. White.

The Tyneside Naturalist's Field Club Transactions	Mr. Bywater.
Carpenter's "Vegetable Physiology"	Mr. Groves.
"The Microscope," by Dr. Carpenter	Dr. Ramsbotham.
24 Slides	Mr. T. C. White.
12 Slides	Mr. Hailes.
6 Slides	Mr. Groves.
6 Slides	Mr. J. F. Pickard.
6 Slides	Mr. Walker.
Photograph printed by the Albertype Process ...	Mr. Groves.
A new brass Tank Microscope, with 4in. objective, in Mahogany Case	Mr. Ross.

The Secretary drew especial attention to the handsome present from Mr. Ross, and to the liberal manner in which he had followed up his suggestion made at the previous meeting.

A vote of thanks to the donors was unanimously carried.

The following gentlemen were elected members of the club :—Mr. Joseph F. Gibson, Mr. F. Johnson, and Mr. Henry King.

The meetings and excursions for the ensuing month were announced by the Secretary, and the proceedings terminated with a conversazione, at which the following objects were exhibited :—

Wing of large Yellow Under-wing Moth..................	by Mr. Golding.
Leaf of Loasa Tricolor..	Mr. B. D. Jackson.
Polyxenus Lagurus and hairs of ditto .... / Fly and 3 parasites	Mr. S. J. McIntire.

AUGUST 26TH, 1870.—*Chairman*, PROFESSOR LIONEL S. BEALE, F.R.S., PRESIDENT.

The following donations were announced :—

"The Monthly Microscopical Journal"	from the Publisher.
"Science Gossip"	the Publisher.
"Land and Water" (weekly)	the Editor.
"The American Naturalist," August, 1870 ...	in Exchange.
"Hogg on the Microscope," 1st Edition... / "Pritchard's Infusoria," 1st Edition ...	Mr. M. C. Cooke.
1 Slide...	Mr. L. Bennett.
50 Slides	Mr. M. C. Cooke.
6 Slides	Mr. W. Hainworth, jun.
11 Slides	Mr. Oxley.
36 Slides	Mr. Quick.

The thanks of the Club were returned to the donors.

The following gentlemen were balloted for and duly elected members of the Club :—Mr. Martin Burgess, Mr. John Carpenter, Mr. Frank Clarkson, Colonel Hennell, Mr. John Hirst, Robert Henry Houlston, Mr. Samuel Warburton.

Mr. T. C. White read a paper "On papers for the Club."

Mr. M. C. Cooke said he should be glad to hear some discussion upon this subject; personally he felt very much obliged to Mr. White for bringing it forward, for he had often tried to stir up members to produce papers, but all the

answer he got was "do it yourself." He *had* done it again and again, and thought it was now quite time that others should be brought up to the scratch. If no one answered the paper he should take it for granted that by their silence members fully agreed with Mr. White's remarks, and that plenty of papers would be the result.

Mr. Curties communicated to the Club an interesting letter which he had received from Mr. Davis, "On the eggs of some parasites found upon birds in the Zoological Society's Collection." The subject was illustrated by some beautiful drawings, and by a number of photographs presented for distribution amongst the members.

A vote of thanks to Mr. Curties for his communication was proposed by Mr. Brain, seconded by Mr. Jacques, and carried unanimously.

Mr. M. C. Cooke read a communication from New York, relative to the amplification of *Pleurosigma angulatum*, shown at the Bailey Microscopical Club, as mentioned at the previous meeting. A photograph of the appearance of the object on the scale described was exhibited to the meeting, but in reply to a question from Dr. Matthews, Mr. Cooke stated that the photograph was not taken from the object itself, but from *a plaster model representing its appearance.*

A vote of thanks to Mr. Cooke was unanimously carried.

The Secretary announced that he had received a letter from the Secretary of the Liverpool Microscopical Society, expressing a desire that at the Soirée in connection with the forthcoming meetings of the British Association at Liverpool the Microscopical Societies should be represented. The Soirée would be held at St. George's Hall, on Sept. 22nd, and members desirous of exhibiting on that occasion were requested to make an early intimation to that effect to Mr. C. H. Sterne.

The following objects were exhibited :—

Seed of Nemesia	by Mr. Chas. Collins.
Scales of Hippophæ rhamnoides	Mr. Conder.
Eggs of Bird Parasites, shown both in the wet and the dry states	Mr. Curties.
Head of Cysticercus, from the Hare	Mr. Groves.
Degeeria domestica (alive)	Mr. Oxley.

There were also placed upon the table for distribution amongst the members a quantity of thin sections of rhinoceros horn and some chrysalids, from Mr. Archer; a large number of named specimens of mosses, from Mr. M. C. Cooke; and a supply of volvox, collected at Woodford, from Mr. W. Hainworth, jun.

Mr. McIntire observed that the Degeeria exhibited by Mr. Oxley was interesting, as being the third discovery of it in England.

The proceedings then terminated with the usual conversazione.

R. T. Lewis.

Manipulation with Canada Balsam.

By D. E. Goddard.

(Read 23rd February, 1866.)

I cannot flatter myself that the remarks I have the honour of bringing before you contain anything new, or that I shall interest or instruct the majority of my audience ; nor should I take up the time of the Association except in the hope that I may assist some of those who are just commencing the study of microscopical science.

There is no royal road to learning; there is nothing, however trivial, to be accomplished in microscopic manipulation without patience and perseverance. Very often an instrument is purchased, and with generous enthusiasm the student dashes into the pursuit of knowledge, and fancies that he can, by some magic process, fill his cabinet with his own preparations. With such objects as require to be mounted dry, he succeeds pretty well; but when he comes to manipulate with Canada balsam, he often meets with failure after failure; and, perchance, instead of persevering till success crowns his efforts, he retires from the contest disgusted and annoyed. Such has been the career of many. I trust it will be for this Association to extend a helping hand to the beginner to smooth some of his rugged paths, and enable him to surmount, with ease and pleasure, those obstacles that others have only passed with great difficulty and much loss of time.

I have chosen for my subject—"Manipulation with Canada Balsam."

I purpose noticing—

First.—The medium generally.

Secondly.—Some of the sources of failure, and show how they may be surmounted.

Thirdly.—The use of chloroform and balsam.

First.—The "Micrographic Dictionary" states that Canada balsam is the liquid resin obtained by tapping the Pinus balsamea. It is

nearly colourless, and more or less viscid. Its boiling point, as far as I can ascertain by experiment, is about 160 centegrade (320 Fah.) If exposed to the action of the atmosphere, it becomes thick; when heated repeatedly, it is rendered brittle, and often passes to a brown, or straw colour, lighter or darker, according to the degree of heat to which it has been subjected. If brought into contact with humid matter, a white cloudiness ensues that will render the medium useless. It is soluble, to a greater or less extent, in camphine, alcohol, naphtha, benzole, chloroform, æther, and crystal oil. It is insoluble in water. When I first attempted to prepare my own slides, I was misled, and met with many failures by following the advice contained in some books and papers recommending the use of "old balsam." My objections to it are, it is too thick to enter the minute vessels in animal and vegetable structures, and retains air-bubbles instead of occupying their space. To render it available, it requires heating more or less; this, often repeated, renders it too brittle to trust. It is often discoloured, and sometimes presents a very yellow appearance. It has, however, the advantage of hardening rapidly; but, even this, under some circumstances, is much against its use. The Canada balsam obtained at opticians will generally answer very well. It should be of such consistence as will drop readily from a glass rod; if the drops are long in falling, it is a proof that the medium is too thick. When such is the case, it can be made fit for use by the addition of camphine or turpentine. The balsam must be warmed in a water bath (about 50 cent.) and placed under the exhausted receiver of an air pump. The question may here be asked—What kind of vessel is the best to keep the medium?

I object to corked bottles, because the cork is liable to adhere to the glass, and small pieces get broken away and fall into the balsam. A stoppered bottle is also open to criticism. When the balsam soils the neck, the stopper adheres to it, requiring the aid of heat to loosen it, and the hardened balsam prevents the total exclusion of the air, and the medium gets thick.

I prefer using a conical capped gum-pot, the outside neck of which is ground, the cap thereby fitting like a stopper. If any balsam falls on it, it may be cleared off without any fear of soiling the medium.

So much for the general properties of Canada balsam. We will now notice, in the

Second place, some of the sources of failure, and how they may be overcome.

Foremost among these must be considered those plagues of the amateur—air-bubbles; these generally arise from three sources.

1.—Bad, or thick balsam, in which case it must be thinned, as before mentioned.

2.—Expansion of air contained in cellular tissue, or minute or intricate vessels. The only method by which such annoyances can be avoided is by lengthened soaking in camphine or turpentine, and submitting the preparation to the action of an air pump.

The 3rd source of air-bubbles is the application of too great heat to the slide, by which the balsam is boiled. The method by which this can be corrected I shall notice presently.

I may here perhaps caution the student against discarding preparations simply because air-bubbles are present. When the balsam is in good condition, and no heat, or, at most, very little has been applied, he will generally find they will disappear in a longer or shorter period, according to the nature of the specimen mounted. Many slides that I have thrown aside and forgotten, have, in the course of a few months, been discovered in my "spoiled box" in a beautiful state of preservation, every bubble having vanished. The object to be attained by mounting in balsam is to render the specimen transparent, which would otherwise be too opaque for observation by transmitted light. Most objects for the polariscope require to be mounted in some medium. Balsam and glycerine are the favourites for some objects, such as crystals, that would be decomposed by balsam, or dissolved by glycerine. Castor oil may be used with advantage.

I do not wish it to be understood that I advise the use of Canada balsam for every kind of preparation; it will be for the student to find by practise how far it may be made available.

It should be established as an axiom in microscopical manipulation—*That the specimen should invariably be soaked for a longer or shorter period in the medium in which it is to be preserved.* Thus, when balsam is the medium, soak in turpentine, or what is infinitely better, camphine; when glycerine is used, let the specimen be placed in it, and in all cases submitted to the air pump. A cheap and very effective form of air pump can be obtained from Mr. Baker, 244, Holborn; the price is, I think, 18s.

When preparing insects for the microscope, I know it is usual

to digest them in solution of potassa, to soften hard structure, so as to get the object as flat as possible. For some subjects this mode of treatment may be required, but I have seldom used it. I place small insects in camphine, and let them remain for months, having previously perforated the abdomen. I find this advantage; the muscular structure is not destroyed, and insects prepared in this manner present a very beautiful appearance by polarized light.

I cannot help thinking that the application of heat by means of a water bath, would effect a great saving of time in all preparations of this character, and be very useful in very many operations connected with microscopy.

There are three methods of applying the balsam.

1.—Place the object on the slide, and let a drop fall on it.

2.—Place a drop on the slide, and push the object into it.

3.—Place the object on the slide, cover with thin glass, and drop the balsam at the edge, and let it run in by capillary attraction.

I do not pretend to say which of these is the best; the student will soon find out which is the most convenient and produces the best results.

Drying.—Having now noticed the preparation and mounting of the specimen, the next question is, how is it to be hardened and finished? This is easy to ask, but not so easy to answer. Some authorities advise placing the slide on the mantlepiece of a warm room, some the use of an oven after the day's fire has gone out; many suggest a flat metal table, heated by a gas or spirit lamp, and others again advocate the water bath; I have tried each of these methods. The first is only to be advised when the student does not wish to finish his preparation for some long period, or when, from the nature of the object, or the presence of air bubbles, he wishes it to dry very gradually. The oven I have found very inconvenient, and cannot recommend it, as the degree of heat cannot be regulated with the precision that is necessary. The water bath I consider infinitely preferable to a flat metal table; both these methods are, I think, open to the same objection. When a flat metal surface is used, the centre of the slide comes in direct contact with the heated surface, and the heat obtained, especially from a flat table, is more than many structures will bear without undergoing such alteration as will render them of little value to the student, and unless the lamp is very carefully watched and regulated, bubbles may arise at any moment and the balsam boil.

The water bath—especially a small one—is much more under control, and by carefully regulating the temperature, can even be used with advantage when manipulating with chloroform and balsam. From many experiments and numerous disappointments, I arrived at this conclusion. The centre of the slide should never be allowed to come in contact with hot metal, either on a water bath or table. I, therefore, in 1863, designed a table; the drawings and measurements are fully explained in a paper I read before the Microscopical Society of London, in January, 1864, and which was published in the "Journal of Microscopical Science" for that year. I have used it incessantly since that time, and I have never found it fail when ordinary care was taken. I have left a batch of 12 slides on it for 50 hours, the lamp burning underneath, and have never found the balsam boil. It is impossible to boil the balsam unless a very large flame is urged for a long time. I once imagined that slides required long continued heat, in order to harden the balsam sufficiently to be cleaned off. That opinion has been very much modified; my plan now is to submit them to a moderate heat for some 15 or 20 minutes, and then suddenly to remove them to a cold plate of metal of about $\frac{1}{8}$th of an inch in thickness, where they are allowed to cool. This, repeated several times, will generally be sufficient, and a very convenient method of getting rid of any air bubble without the risk of spoiling the preparation by pressure, the sudden contraction of the balsam answering the requirements.

Another fruitful source of annoyance is the appearance of a white cloudiness, which spoils many carefully mounted specimens. This may arise from two sources.

Dampness of the specimen, or the presence of grease or fatty matter that has not been carefully removed before applying the balsam.

If a section of any sponge, such as may often be found on our sea coast, be mounted months after it has been gathered, this cloudiness will ensue, because it has not been thoroughly dried. To avoid such mishaps, I employ one of three methods.

1.—Heat, sometimes direct, but more generally by means of a water bath.

2.—By digesting the structure in strong alcohol before placing it in camphine.

3.—By using a sulphuric acid bath, which consists of a large

jar, containing a smaller one partly filled with the strong acid. Chloride of calcium would answer the same purpose.

The object is placed on a slip of glass over the vessel containing the drying agent, and the whole rendered comparatively air tight by a disc of glass, with greased edges placed on the top of the large jar. This plan I think most generally useful.

To remove grease or fatty matter, I generally employ benzole. Unless this precaution is taken, and, say fish scales, are mounted, the preparation will probably be a failure.

To illustrate the methods of drying with alcohol and the acid bath, I will give an example of each.

Suppose a section of wood is required. I take a twig of any bough—say hazel; having cut my section, I place it in strong alcohol, where it remains for at least one week; it is then transferred to camphine, in both processes it is submitted to the air pump.

Again, I have injected a kidney with gelatine and carmine; with a valentins knife I cut the section, and as heat could not be applied without liquifying the gelatine, I place it in a vessel such as I have described. In a few weeks it is sufficiently dry to mount; all the moisture having been absorbed by the sulphurie acid or the chloride of calcium.

We now come to the final cleaning and finishing. Nothing is more deceptive than the apparent state of the balsam. Often have I finished a number of slides that I imagined were sufficiently set, and in the course of a few weeks the object has entirely disappeared in the rim of varnish.

To ascertain whether the balsam is sufficiently set, I try it with my nail; if any indentation is produced, I repeat the hardening process, until, when cold, the nail only scratches.

The superfluous balsam may then easily be chipped off with a knife. It is possible to clean slides at an earlier period. First remove the excess of balsam with a warm knife, then brush briskly with a soft tooth brush, dipped in mythelated spirit, and finally wipe with a clean white handkerchief.

The size and nature of the object, and also its destination, must decide the operator which of these methods will be most advisable. With large objects such as wood sections, algæ, &c., the balsam need not be so thoroughly hard as when the slide consists of small dense particles, such as diatoms, foraminifera, sponge, spicules, sections of hairs, &c.

When the cabinet for which they are destined consists of trays in which the objects lie flat, the same care need not be taken as when they are placed in boxes fitted with ordinary rack work. The use of the brush is much safer than wiping the slide with a cloth; many a slide can be cleaned by the former method, when it would be utterly impossible to do so without moving the cover when the cloth is employed. Mythelated spirit, benzole, camphine, or turpentine, and naphtha, are very good solvents for this purpose, the first being the cheapest, and it has this advantage—it has no unpleasant smell.

Having cleaned, the next process is the finishing. Many first-class preparers do not use any rim of varnish. I prefer doing so, not that I think that asphalte varnish is much protection, but because I think it improves the appearance of the slide. I should not advise the student to trust to asphalte alone; it is more or less brittle. There is another accident which must be guarded against; if the balsam be not sufficiently set, the varnish will run over the field and completely spoil the preparation. To prevent such annoyance and give still greater security to the cover, I prefer running a rim of gold size round it, and when hard applying an upper surface of varnish. I may mention that I have used asphalte and gold size mixed in the proportion of two of asphalte to one of gold size with great advantage.

The labels to be used vary with the taste of the preparer. Round disks are less expensive, and look neater than others. I have found the ruled square labels, sold by Messrs. Smith and Beck, the most convenient, as affording room for such particulars as are sometimes necessary.

The third division of this paper relates to chloroform and balsam. I shall not detail the experiments that have occupied me during the past few months; I will simply state, in the form of a summary, those conditions that I consider necessary to ensure successful manipulation with this medium.

1.—Old balsam must be used, and should be sufficiently hard to resist the impression of the point of the nail. If none is to be met with, a bottle of ordinary balsam should be heated in a water bath till the requisite degree of hardness be obtained.

2.—Great care should be observed in selecting the best and purest mythelated chloroform (it is much cheaper than pure chloro-

form), that made by Messrs. Duncan, Hockhart, and Co., of Edinburgh, will be found excellently adapted for the purpose.

3.—The same precautions should be taken as when using ordinary balsam, such as thoroughly drying the specimen, freeing it from all fatty matter, and submitting it to the action of the air pump.

4.—Heat may be applied with advantage, but it must be with great caution. As far as I can ascertain, it should not exceed 64 cent. (147 Fah.) On cooling, all bubbles disappear, if not at once, in the course of a few days. The balsam hardens immediately on cooling, when it has been subjected to a gentle heat, and is not rendered brittle. Some specimens, such as sections of sponge, &c., should always be allowed to dry or harden gradually, without any application of heat.

5.—Finally, I consider chloroform and balsam an invaluable addition to the laboratory of the microscopist, and capable of being used with advantage in many cases in which ordinary balsams would prove tedious and troublesome.

The effect produced by using this medium is to impart a greater brilliancy to objects mounted in it.

I have endeavoured in this paper to trace the various operations connected with manipulation with Canada balsam. Some of my conclusions may be erroneous—I do not dogmatically lay down principles. I trust that others will either verify my deductions or prove their fallacy by experiment. I shall be most happy to reconsider any part of this paper, and modify any of my statements, provided I can do so on data furnished by the researches of others; in this age of progress, no department of science can stand still. Perhaps others, with greater experience and more complete experiments, will be able to contribute far more valuable material to our common fund of knowledge. I only give certain deductions drawn from the result of my own experiments, and if anything contained in this paper is of the slightest use to any student of microscopical science, or if it induces others to investigate for themselves, I shall not regret having volunteered this paper.

On so-called Spontaneous Generation.

By Benjamin T. Lowne, M.R.C.S.

(Read September 23rd, 1870.)

When I announced a month ago that I would read you a paper on "Spontaneous Generation," I had no idea that one of the greatest living naturalists was going to give a most able *résumé* on the subject, or perhaps I should have hesitated in coming before you. Nevertheless I feel it is a matter for congratulation that I did so, as many unanswered questions have arisen since Professor Huxley delivered his address at Liverpool.

Two hundred and two years ago Francesco Redi successfully combated the then prevalent doctrine of spontaneous generation by the most simple, nay, almost childlike experiments, such as putting meat under fine gauze, and so showing that maggots are not spontaneously generated. Since that day the tendency of experiments has certainly been in .favour of Redi's aphorism, "Omne vivum e vivo."

The question, however, all turns upon that little word *omne*, all; whether all living things originate from germs, or whether some may originate spontaneously from not living matter.

Now, there can be no doubt but that there was a first cell and a first organism which had no progenitor. Professor Huxley said last week, that although he could not believe anything in the absence of evidence upon the subject, that "expectation is permissible where belief is not;" and that if it were given him "to look beyond the abyss of geologically recorded time to the still more remote period, when the earth was passing through physical and chemical conditions, which it can no more see again than a man can recall his infancy," he "should expect to be a witness of the evolution of living protoplasm from not living matter."

To show you that I am not biassed in this matter, and that I am no partisan, I tell you I go farther in my expectation than Professor Huxley, and I think that if we could produce the conditions we might see amœbiform protoplasm originating even yet from

inorganic matter. Perhaps, as Dr. Bastian suggests, colloid may be intermediate between inorganic and organic living material, but I tell you, gentlemen, this is all expectation, and should not be belief, as we have not at present a tittle of evidence in its favour. No doubt, with Mr. Charles Darwin's hypothesis, the origin of living organic from inorganic matter would supply a gap in the evolution of the animal kingdom : but we must not on that account found a scientific belief.

Now, sir, I shall very carefully sift the supposed evidence in favour of spontaneous generation ; I shall divide this evidence into that which is purely microscopical and that which is dependent on experiment.

First, with regard to the microscopical evidence. This consists in the assertion, that some observers have seen organic living cells and fungus spores built up by the aggregation of minute granules. Now, there is very strong evidence that this does not happen ; the organisms described as fungus spores are in some cases not fungus spores at all, and in other cases they have been observed with a hilum or point at which they were attached to a parent. Surely we cannot believe this point of attachment was the character of a spore formed *de novo*.

On the other hand, I should be sorry to deny, with my present knowledge, that it is possible organisms of a simpler kind, such as unicellular organisms, may be built up in this way. If such a mode of evolution does take place, I still believe it is from pre-existing germs ; such gemmules, for instance, as Mr. Darwin believes in, in his beautiful provisional hypothesis of pangenesis. I believe, if it can be proved that organisms can be produced by aggregation, it will be found that this only takes place when pre-existing cells have given up their contents in the fluid experimented on.

In order that you may have a clear conception of Mr. Darwin's theory, I will read to you, to my mind, far the most lucid abstract of that theory that has ever been published. It is a portion of Dr. Hooker's address to the British Association at Norwich, in 1868.

Dr. Hooker said—" You are aware that every plant or animal commences its more or less independent life as a single cell, from which is developed an organism more or less closely similar to its parent. One of the most striking examples I can think of is afforded by a species of Begonia, the stalks, leaves and other parts of which are superficially studded with loosely attached cellular

bodies. Any one of those bodies, if placed under favourable conditions, will produce a perfect plant, similar to its parent. You may say that these bodies have inherited the potentiality to do so, but this is not all, for every plant thus produced, in like manner developes on its stalks and leaves myriads of similar bodies, endowed with the same property of becoming new plants; and so on, apparently interminably. Therefore the original cell that left the grand parent, not only carried with it this so called potentiality, but multiplied it and distributed it with undiminished power through the other cells of the plant produced by itself; and so on, for countless generations. What is this potentiality, and how is this power to reproduce thus propagated, so that an organism can, by single cells, multiply itself so rapidly, and within very narrow limits, so surely and so interminably? Mr. Darwin suggests an explanation, by assuming that each cell or fragment of a plant (or animal) contains myriads of atoms or gemmules, each of which gemmules he supposes to have been thrown off from the separate cells of the mother-plant, the gemmules having the power of multiplication, and of circulating throughout the plant: their future development he supposes to depend on their affinity for other partially developed cells in due order of succession. Gemmules which do not become developed, may, according to his hypothesis, be transmitted through many succeeding generations, thus enabling us to understand many remarkable cases of reversion or atavism. Hence, the normal organs of the body have not only the representative elements of which they consist diffused through all the other parts of the body, but the morbid states of these, as hereditary diseases, malformations, &c., all actually circulate in the body as morbid gemmules.

"As with other hypotheses based on the assumed existence of structures and elements that escape our senses, by reason of their minuteness or subtlety, this of Pangenesis will approve itself to some minds and not to others. To some these inconceivably minute circulating gemmules will be as apparent to the mind's eye as the stars of which the milky way is composed: others will prefer embodying the idea in such a term as potentiality, a term which conveys no definite impression whatever, and they will like it none the less on this account.

"Whatever be the scientific value of these gemmules, there is no question but that to Mr. Darwin's enunciation of the doctrine of

Pangenesis we owe it, that we have the clearest and most systematic *résumé* of the many wonderful phenomena of reproduction and inheritance that has yet appeared; and against the guarded entertainment of the hypothesis, or speculation if you will, as a means of correlating these phenomena, nothing can be urged in the present state of science. The President of the Linnean Society, a proverbially cautious naturalist, thus well expresses his own ideas of Pangenesis—' If,' he says, ' we take into consideration how familiar mathematical signs and symbols make us with numbers and combinations, the actual realization of which is beyond all human capacity; how inconceivably minute must be those emanations which most powerfully affect our sense of smell and our constitutions; and if, discarding all preventions, we follow Mr. Darwin, step by step, in applying his suppositions to the facts set before us, we must, I think, admit that they may explain some, and are not incompatible with others; and it appears to me that Pangenesis will be admitted by many as a provisional hypothesis, to be further tested, and to be discarded only when a more plausible one shall be brought forward."'

I have brought the subject of Pangenesis before you to-night because I believe I have observed certain very remarkable changes in the tissues of the larva of the fly prior to the formation of the perfect insect, which have prepared me to believe it is possible that organs or organisms are sometimes developed by aggregation of excessively minute gemmules, such as those which Mr. Darwin's hypothesis demands.

From observation which I made upon this subject, I found that the semi-fluid cellular matter, from which the fly is developed, is derived partly from the disintegrated tissues of the larva, and partly from the fat bodies or omenta.

After the larva ceases to feed, the tissues begin to degenerate. The muscles may be observed at this time in a state of continuous activity, rythmic contractions commencing at one extremity of each set of fibres, and passing regularly with a wave-like motion to the opposite extremity. At the same time, large bright nuclei, 1-1000th of an inch in diameter, appear in rows in the centre of the muscular fibres. These are ultimately set free by the degeneration and waste of the muscles, and exhibit a granular appearance, but are readily distinguished by their great transparency and low refractive power.

At the same time a series of remarkable changes take place in

the fat bodies, which consist in the adult feeding larva of flattened hexagonal cells filled with very opaque, highly refractive white granular matter. These cells now begin to exhibit clear spaces in their centre, which presently become converted into nuclei exactly like those formed in the muscles. The granular matter of the omental cell then becomes condensed about the nucleus, leaving a clear space around the circumference of the cell; the cells separate from each other, aud the cell wall undergoes disintegration.

The free nuclei developed from the muscular fibres of the larva now begin to collect around them aggregations of molecular matter, derived from the degeneration of the muscles and other larval tissues, so that all the nuclei are soon surrounded by similar molecular aggregations, each about 1-150th of an inch in diameter.

The precise nature of the changes which take place immediately afterwards are more difficult to observe, but after the second day of the pupa state, numerous delicate nebulous-looking cells, about 1-1000th of an inch in diameter, replace some of these aggregations, and bright nuclei, 1-3000th to 1-5000th of an inch in diameter, make their appearance amongst them. The majority of the aggregations remain, however, and become more dense toward their circumference. The growth of the imaginal tissues* evidently proceeds at the expense of some of these aggregations, whilst those which remain, undergo marked changes; they increase in size, lose their original nuclei, and become invested by a delicate membrane. When the imago emerges from the pupa, a large number of these corpuscular aggregations remain in all parts of the insect; they disappear during the development of the imago, and when it is mature, not one can be detected.

If these observations are correct, there is certainly something in the process very like the development of organisms by aggregation; we find nuclei aggregating around them; molecules, which ultimately become invested in a membrane, and these molecules in turn are capable of reproducing muscles, nerves, and other tissues similar to those from which they originated. The development of the perfect fly from the larva seems, to my mind, a striking proof of the correctness of Mr. Darwin's theory of pangenesis, and also to point to the fact, that organisms may originate in a hitherto unknown manner. Even admitting that this method of origination is possible, we must not conclude that such organs or organisms

* Tissues of the Imago or perfect fly.

arise *de novo*, but rather by the aggregation, and after development of existing germs or gemmules.

With regard to the experimental evidence, it has been arrived at from two classes of experiments.

The first aims at the production of known organic forms from solutions of animal or vegetable matter. The second aims at the production of new and unknown forms, under new conditions in saline solutions.

I shall consider these two sets of experiments separately.

In the first, or simplest set of experiments, the most contradictory evidence has been arrived at by different observers. The whole, to my mind, may, however, be summed up in the following.

If we receive the usually accepted belief that the boiling temperature destroys germs, we must accept spontaneous generation as a fact. If, on the other hand, we believe that germs are not killed in this manner, these experiments only show that if the greatest possible care is used, germs may not be admitted and a negative result may be arrived at, and yet that germs may find their way into the flasks of the most careful experimenter, and may afterwards germinate.

Now, sir, I have instituted a series of the most careful experiments, which have shown conclusively to my mind that germs are not destroyed by the boiling temperature.

I took a neutral solution of acetate of ammonia and put into it a number of spores of the little mould known as *Penicillium glaucum*, and boiled them well. I then enclosed some of the boiled fluid and germs in capillary glass tubes, like those used for preserving vaccine lymph. I then carefully examined the tubes by scrutinizing them with the microscope for an hour each, and not a spore had germinated, not a mycelial filament existed in the tubes. I then put the tubes into a warm place by the stove, and in twenty-four hours numerous mycelial filaments of considerable length had protruded from many of the spores. Now, gentlemen, I should think the most hardy advocate of spontaneous generation would hardly assert that these spores had originated *de novo*, and germinated in a single night and day.

To make the experiment more complete, I enclosed in another tube some spores which had not been boiled, and I found about the same number had germinated in this tube, as in those containing the boiled spores.

I have tried another set of experiments of a similar kind. I

boiled a vegetable infusion containing a quantity of the bead-like growing mycelium of some fungus, probably a state of *Penicillium*, and mounted a few portions in a cell for the microscope. I then carefully examined and drew these portions, and watched them from hour to hour, and saw new cells formed and new buds put out. I have done this again and again with the same result.

I have further found that this process is arrested in sealed tubes after a few hours ; I cannot tell why, but I strongly suspect from the absence of dissolved air in the fluids : Mr. Cooke has suggested it may possibly be from the absence of dissolved nitrogen. I strongly suspect it is from this fact that we are able to preserve meats, &c., *in vacuo.*

Of this at least there can be no doubt, both the growing mycelium and the spores of the common blue mould, *Penicillium glaucum*, will grow after boiling, and it is nevertheless possible to preserve meat, &c., on a large scale, by enclosing it *in vacuo* after boiling it.

I may here remark that Dr. Bastian's eighth experiment,* in which he found that an infusion of turnip decomposed more rapidly when enclosed *in vacuo* than a similar solution enclosed in a flask containing air, is simply incomprehensible, and is a contradiction to the well-known process of preserving meats, vegetables, fish, &c.

I think, sir, very few will believe we are justified, *without evidence*, in believing a temperature somewhat higher will kill these spores if boiling does not. I therefore look upon it that no evidence is afforded by such experiments,—as those I have included under this first division,—in favour of generation *de novo*, if my observations are confirmed.

The second series of experiments, which aim at the production of new and unknown organisms, afford a wider field for speculation. I must confess, however, that in every case which I have seen, these so-called new organisms have appeared to me undoubtedly foreign bodies, which have accidentally gained access to the solutions.

The most recent experiments of this kind were carried out by Dr. Bastian, and their results have been published in " Nature." In these experiments a solution of sodic-phosphate and ammoniac carbonate was enclosed *in vacuo* whilst boiling, and certain spiral fibres and portions of a fungus, like *Penicillium* in fruit, were found after a time in the solutions.

With a view to discover whether the spore-bearing portions of *Penicillium* would remain unaltered after boiling, I tried the unripe

* " Nature." Pt. xxxvi., p. 194.

spore-bearing filaments, and found that they were not altered in their appearance by such treatment. The ripe spores are, however, immediately scattered by contact with fluid. Now I can readily understand why no fungi were discovered until after a long lapse of time, in Dr. Bastian's solutions; although some might have been present from the first. I find solutions of sodic phosphate throw down a flocculent precipitate after a time, and in those specimens which Dr. Bastian was courteous enough to show me, I observed that the object was surrounded by just such a precipitate, which he called correctly enough granular matter. I suspect the collection of such a flocculus around the fungus drew his attention to the spot where the minute mass of fungus was.

Another reason for not believing that the fruit-bearing stems of *Penicillium*, which Dr. Bastian figures, were formed in the solutions, is that these fungi never fructify in fluid. My friend Mr. M. C. Cooke tells me that he never heard of any fungi, except such as are parasites on insects, fructifying in fluid, or so long as a plentiful supply of fluid is present. As he very forcibly put it, take the vinegar plant as an example; so long as there is plenty of fluid, it never produces fruit; but take it out of the fluid, and its surface will soon be covered with blue mould. With regard to the so-called spiral fibre organisms of Dr. Bastian, they have puzzled me very much. I never, however, believe but that they were some very common accidental material which had found its way into his solutions. I observed that he only found these "organisms" in solutions containing sodic phosphate. I have tested and had tested for me three samples of crystals of this salt, and in all free soda was present. I have since tried the action of very dilute solutions of caustic alkali on various kinds of organic fibre, and have found wool fibres, minute particles of feathers, and some kinds of spiders' thread twist into spirals under its influence. Now, the spirals produced from spider's silk correspond most closely with Dr. Bastian's spiral fibre. In my own mind I have no doubt the specimen he kindly showed me was spider's silk.

At any rate I do not think, in the face of this, we ought to conclude that we have discovered spontaneous evolution from the appearance of spirals in an alkaline solution.

I apprehend then, sir, from what I have said, if my experiments are confirmed, which can easily be done, that at present, let our "philosophic faith be what it may," we have no evidence whatever of spontaneous evolution.

Mobility of Spines on Certain Insects' Eggs.

By H. Davis, F.R.M.S.

(Communicated by Mr. Curties. August 26th, 1870.)

The following communication from Mr. Davis, addr ssed to Mr. Curties, was read by that gentleman :—

Encouraged by your opinion that my observation of the mobility of spines on certain insects' eggs, would be a suitable offering to the Quekett Club, I venture to send some brief notes thereon, a few objects and illustrative drawings for exhibition at the meeting, and a parcel of photographs for distribution among the members. The discovery, such as it is, is a simple matter, and lies in a nut shell, or rather in an egg shell. You know that the eggs of some bird parasites have lately attracted much attention from their novelty and peculiar beauty ; foremost among them, the eggs found on the black-quilled Peacock, and on the Mallee bird : now the elegantly curved petaloid spines on the former quickly uncurl, straighten, and contract on the lid *when the egg is placed under water.* They remain thus closed until the water is removed, when, as the egg becomes dry by evaporation, the spines loosen ; they gradually and gracefully recurve until the egg again assumes its flower-like form. A group of these eggs in drying make a pretty sight in the microscope,—it is a bouquet of flower-buds actually blooming under the eye of the observer.

The action of the spines seems independent of vitality, and is renewed apparently as often as moisture is applied or removed; thus, on one of my slides, some of the lids are gone and the shells empty, while the contents of other unhatched eggs are shrivelled and dead; still all the spines continue to contract and expand on provocation after a score of immersions.

The parasite eggs found on the Mallee bird possess appendages actuated precisely as are those of the species described; these are

the only two I have examined, but it is likely that a few experiments with water on some of the many insects' eggs which bear spines and wing-like processes, would lead to interesting results: desirable also is careful examination with a view to detecting the *cause* of the spines uncurling when wet. An unequally greasy appearance in the eggs when partly dry, leads me to think that one side of each spine is much more absorptive than the other, a quality which would readily account for its activity in water; but this is a mere suspicion, and of no scientific value.

Without pretending to any exclusive knowledge of Nature's object and intentions in this case, and indeed, making only a modest guess at them, I may suggest the probability that the contracted state of the spines over the lid in wet weather only, strengthens and bars that outlet for the time, perfectly restraining the hatching of even mature eggs until the advent of dry favourable weather.

The tender provision for the meanest of insects implied in this arrangement is most obvious; the inevitable pointed moral being equally so, I am left but a single reflection to conclude with—thrice happy are those creatures who are well provided against a rainy day!

Sections of Coal.

By J. Slade.

(Read October 28th, 1870.)

The origin of coal has ever been a subject of great interest to the naturalist; but so far as the microscope has been concerned in the investigation, no satisfactory progress has been made until quite recently.

The examination of sections of coal under low powers, either as transparent, or opaque objects, is almost useless; but sections, averaging between the two and three-hundredths of an inch in thickness, under a quarter, or an eighth objective, show a structure as unmistakably as do sections of recent vegetable organisms. The teachings resulting from examination of such sections have been truly and clearly brought before the public by Professor Huxley in a lecture at Bradford in January last, and again at Leicester in November last, and reported in the "Contemporary Review." The means of confirming these observations is in the hands of anyone accustomed to prepare objects for the microscope, while the material is close to our hands at any moment. The method of proceeding is as follows:—

A piece of coal being selected, a surface is at first obtained roughly by a file, or piece of sandstone; then a finer, by means of a hone, or piece of fine glass paper; then a still finer, by means of pumicestone, and after rubbing upon Arkansas stone, finally brought to the highest polish possible by friction upon plate glass.

If the coal be very friable (which it sometimes is), it will be necessary to macerate the specimen in thin shell lac varnish and dried, before the whole process can be accomplished.

In order to secure success, it is impossible to bestow too much pains in this preliminary operation.

Having made a good surface, next cement it to a glass slip by

marine glue; the marine glue used, requires careful selection; that usually sold frequently contains particles of the undissolved materials, which are visible enough under the microscope.

However, having obtained the right sort, cut thin slices; lay them upon the glass slip, and melt over a flame; when thoroughly melted, drop the specimen (the polished surface being downwards) into it, and press out the air bubbles When air bubbles appear between the glass and the surface of the coal—which they often do, and sometimes prove very annoying—they must be got rid of; otherwise it is useless to proceed, for long before the specimen is thin enough to show structure, the coal over the air-bubble comes away, leaving a hole. If they be not present, the preparation may be proceeded with, first reduced on sandstone, and then finished by pumicestone; and after scraping away the superfluous marine glue, mounting in Canada balsam, and covering in the usual way.

As the preparing goes on, the specimen will be occasionally viewed under the microscope. The first to appear will be the spore cases, and a careful continuance of the grinding will finally render the spores visible.

Spores and spore cases are to be found in every successful preparation of coal; but their relative proportions and degree of preservation vary considerably; thus Wigan Cannel almost entirely consists of spores, very few spore cases. Bradford coal, spores and spore cases in nearly equal proportions. Silkstone coal, spore cases few, and much compressed spores in abundance. Moira coal, Leicestershire, spore cases beautifully preserved, and in some, spores *in situ*. Dalkeith coal, the same, the spore cases, on the whole, being slightly more compressed. Wallsend, spore cases much compressed and altered, and mixed up with a quantity of grit and amorphous bituminous matter. White coal, of Australia, consists almost entirely of spore cases.

On a Neutral Tint "Selenite Stage."

By W. Ackland.

(*Read November* 25*th*, 1870.)

In using polarized light with the microscope, many objects possess so slight a depolarizing influence, that a selenite film must be used to bring out some structure not otherwise visible, or a display of colours that could not otherwise be obtained.

Selenite films, yielding the various tints of blue, green, yellow, red, and purple, are commonly employed; but, anyone using these, must have noticed, when viewing an object not entirely filling up the field of view, that the colour of the background thus formed fails to harmonize with the colours of the object under examination; and, indeed, more frequently the effect is considerably marred by want of contrast.

Now, my object in addressing you this evening is to recommend you to try the neutral or pale bluish violet colour, corresponding to the tint that occurs in Newton's rings, between the violet of the second and the indigo of the third wave, and as used by Soleil in his Saccharometer.

This tint cannot be readily obtained by splitting selenite, but is easily produced by superimposing two suitable films; and, when thus obtained, is exceedingly delicate in action, as its colour is varied by the slightest depolarizing influence of the object under examination; indeed, it is often changed to either violet or blue by the action of the thin glass cover, or a slight tension of the mounting medium.

To gain the fullest advantage of this neutral tint, I have devised an efficient, but simple selenite stage, which, when in use, is laid on the microscope stage and the object on it.

It consists of two films—one the primary, capable of being rotated by the milled head on the right-hand side, and the second,

or compensating film, which is rotated by the finger being pressed against its projecting milled edge.

When used, first rotate the polarizer, or analyser, until a dark ground is obtained, then remove the compensating film, and place the selenite stage on that of the microscope, rotate the primary film until its greatest intensity of colour is obtained; now add the compensating film, and rotate that by the finger until the colour is changed to a light neutral tint, midway between reddish purple and indigo blue.

This being obtained, place the object to be examined on the selenite stage and focus it.

Now, if the thin glass covering of the object has changed the tint of the background, rotate the compensating film until the neutral tint is restored; then notice the effect produced, and vary slightly the position of both primary and compensating films until the maximum brilliancy is obtained; but, it may be noticed, that with some objects possessing very slight depolarizing influence, the maximum effect is yielded when the primary film is first rotated (not as above advised until it yield the greatest brilliancy of colour), but when rotated until its brilliancy is nearly at a minimum.

Indeed, each object will require some slight variation of position of one, or even of both films; but these are easily found by trial.

In conclusion, I boldly assert, that with this simple stage, any object requiring its use can be seen to as great, if not greater, advantage than with selenite stages of treble the cost, and that the neutral tint I advocate will shew all of our ordinary polarizing objects far more effectually than when viewed with the ordinary selenite films; but, should variation of colour be deemed necessary, the mere rotation of the compensating film will at once yield an abundance of tints from which to select.

PROCEEDINGS.

SEPTEMBER 23rd, 1870.—*Chairman*, DR. LIONEL S. BEALE, F.R.S., President.

The following donations to the club were announced:—

"Land and Water," (weekly)	from the Editor.
"The Monthly Microscopical Journal" ...	the Publisher.
"Science Gossip"	,,
"The American Naturalist"	in exchange.
Report of the Surgeon General of the U.S. Army, on certain points of the Histology of minute blood vessels, illustrated by 13 micro-photographs; also his report on the use of the oxycalcium light in micro-photography ...	Lieut.-Col. Woodward.
Cooke's Handbook of Fungi (Part 1)... ...	Mr. Quick.
Dr. Deane's Work on the gray substance of the Medulla ... ... Dr. Brewster's Treatise on the Microscope	Mr. M. C. Cooke.
25 Slides of Marine Algae	Mr. C. Adcock, of Jersey.
1 Slide of Winged Seed	Mr. C. Collins.
3 Slides of Chigoes	Dr. Gray.
1 Slide of Gizzard of Cockchafer	Mr. Quick.

The thanks of the club were returned to the donors.

The following gentlemen were balloted for and duly elected members of the club:—Mr. George Cheverton, Mr. Rochfort Connor, Mr. William Delamore, Mr. Lamartine Burdett Yeoman.

Mr. B. T. Lowne read a paper upon "So-called Spontaneous Generation and the recent experiments described by Dr. Bastian."

A vote of thanks to Mr. Lowne for his elaborate and interesting paper was proposed by the President and carried unanimously.

Mr. M. C. Cooke said that although he did not intend to make any remarks upon the theory of the subject, he could not help doing so upon some of the facts. As for agglutinated atoms forming fungus spores, he could only say this was so extraordinary that he should be very glad to see the fungus spores so formed, more especially because it is not so easy to say what is a fungus spore and what is not. There were very few—he might say there were none—which gave no evidence of a pedicel, so that if these bodies were fungus spores

they would certainly show a pedicel. He then quoted from some papers by Hallier, in which the budding out alluded to had been described and figured. With reference to fungi fructifying in fluids, he believed they had never been known to do so; no forms do so excepting those found on flies and on fish, and which, after all, were doubtful species. As for a Penicillium with spores in situ being found in a fluid, he should be glad to see such a remarkable phenomenon, for it is well known that moisture prevents its fructification. Take a Penicillium which has formed under the cover of a glass slide, and let a little water go under the cover, and instantly every head will fly off, you cannot get the heads to remain on after moisture has touched them. The vinegar plant was another instance; it would grow rapidly but would not fructify so long as it had plenty of moisture; but take it out of its moisture, and it would in a very short time throw up its filaments and produce fruit.

Mr. Lowne said that some of the things which were said to be the spores of fungi certainly had a hilum, and Mr. Smith had pointed out that it was very strange that a thing should have an umbilicus if it never had a parent. With regard to the Penicillium, he believed that the specimen found in the fluid was unripe, and in this state it might remain entire; it was when ripe that the heads flew off upon contact with moisture.

Mr. Golding expressed himself as being very much indebted to Mr. Lowne for his paper, which he believed had thrown considerable light upon this question. He could not help believing that there was a distinction between organic and inorganic matter, and that there was something that we called life. He thought that the evidence seemed conclusive that there were germs in the fluids experimented upon, and Mr. Lowne had certainly shown most conclusively that under his own hands germs which had been boiled had not been destroyed by the process, so that it might reasonably be believed that those found in the fluids of Dr. Bastian had passed safely through all the ordeals which he had detailed. He thought Mr. Lowne deserved especial thanks for the very great pains he had taken to ascertain what those remarkable forms were which had been found in the fluids.

Mr. T. C. White wished personally to thank Mr. Lowne for his paper, and especially for the suggestion which he had thrown out, that the members of the club should take this subject up. He hoped the suggestion would be acted upon, and proposed that at the meeting to be held on March 24th, 1871, those members who were willing to lend their aid would come prepared to give the details and results of experiments made meanwhile.

Mr. Collings said that some doubt appeared to be thrown upon the statement that all the drawings of Dr. Bastian had been made upon the same scale; he had himself made the drawings, and could say that he had in every case used nothing but one of Nachet's 1-12th inch immersion lenses, which had since been returned, and was now besieged in Paris.

Mr. Lowne inquired if the drawings had been made by camera, and upon ruled squares, and was informed that they were.

The President said he was greatly astonished to hear that the drawings had been all made under the same power; it made them quite incomprehensible.

Mr. Lowne said it certainly made the matter much easier to dispose of.

The President observed that there were many drawings made under powers of 2,500 diameters, which seemed far less amplified than those under consideration.

The President having intimated that, as an advocate in the controversy, he

would rather not speak upon it from the chair, since he could not well be both advocate and judge. The chair was taken *pro. tem.* by Mr. Henry Lee, V.P.

Dr. Beale then spoke at considerable length upon the subject, observing that Mr. Lowne had drawn attention to the idea of the formation of living germs by aggregation, but his own conviction was that they were never formed by aggregation. When carefully examined under a very high power small particles might be seen to detach themselves, but no one had ever seen two particles coalesce except in the case of generative organisms. Statements of this kind must, therefore, be received with extreme doubt; indeed, after careful attention to the subject, everyone must come to the conclusion that the general characteristic of living matter is that a particle having attained a certain size divides. After reference to the observations of Pouchet, the speaker said that it would no doubt be interesting to the members to hear that quite recently the experiments of Dr. Bastian had been repeated with great care by Dr. Child in the laboratory at Oxford. Last week Dr. Child and himself had carefully examined the fluids in the flasks, and he must own that the results were very unsatisfactory for Dr. Bastian. They found here and there some very minute Bacteria, so small that they must have been overlooked by Pouchet, and in some there certainly were living organisms, yet they still had, as a general conclusion, these facts, that the more care they took in boiling, sealing, and keeping at a high temperature, the fewer were the germs to be found, and it seemed probable that if it were possible to conduct these experiments with perfect care, then no germs whatever would be found. He confessed that he could himself as soon believe in the spontaneous generation of a mouse, or a rat, or of an elephant, as of any other living organism, the one seemed to be the same in principle as the other; if it were not so, then there must be somewhere a line separating nature into two distinct parts. If this principle of spontaneous generation were to be admitted as proved, then all that one held with regard to the higher animals and of the connection between matter and mind must be swept away. The stake was tremendous. He felt most strongly that the moment he became convinced of this then the whole of his views in this world must be changed. He thought that it was quite right that experiments of this kind should be conducted, but they ought obviously to be conducted with the greatest care, and with regard to those described by Dr. Bastian, he must confess that there appeared to him to have been some very great mistake, because there are, amongst the things figured, some which are comparatively high in the scale of nature, the size also of some of these things as represented also led him to believe that some error must have been made. He would also like to say something on the subject of pangenesis. In many persons it was well known that there were evidences to be found of the peculiarities of their predecessors, and these were to be found in the brain cells, in the nerves, as well as in colour of the iris, and conformation of the features; how was this to be explained? They had recently had some strange ideas propounded by Tyndall, who says that "the earth is surrounded by a medium" which he calls "spirit and matter united together," and that "all the blue sky can be packed in a person's trunk, and that it all consists of germs." What could he mean? For a cell germ to be produced as imagined, the particles must be capable of passing through tissues and through substances as hard as bones and teeth, and these bodies must be detached at all periods of life. The susceptibility of children to the parents' diseases was well-known, as also the fact that particular diseases were developed at the age at which they

had appeared in the parent, so that if the child passed this period of life, the system seemed to lose its susceptibility for that particular disease. How these matters were to be explained by the Pangenesists he did not know.

Mr. Lowne, in reply, thought that it was not more strange that germs should pass out of cells than that nutriment should pass in.

A very cordial vote of thanks to Mr. Lowne was then unanimously carried, and the proceedings terminated with a conversazione, at which the following objects were exhibited :—

Aphides on Lysimachia Nummularia by	Mr. Hainworth and Mr. Quick.
Gizzard of Cockroach	Mr. Quick.
Triceratium, Stylodactylis	Mr. Meacher.
Section of Cannel Coal	Mr. Slade.
Crystals of Borate of Ammonia ...	Mr. Conder.
Caprella Lobata	Mr. T. C. White.

October 28th, 1870—*Chairman*, Dr. Lionel S. Beale, F.R.S., President.

The following donations to the Club were announced :—

"Land and Water" (weekly)	from the Editor.
"The Monthly Microscopical Journal" ...	the Publisher.
"Science Gossip"	,,
"The Popular Science Review"	,,
"Archives of Science and Transactions of the Orleans County Society"	in exchange.
"The American Naturalist"	,,
"Proceedings of the Brighton and Sussex Natural History Society," and "The Moss Flora of Sussex," by Mr. C. P. Smith	the Society.
12 Slides of diatoms	Mr. A. C. Cole, Liverpool.
1 Slide	Mr. Tatem, Reading.
"Land and Fresh Water Shells"	Mr. T. Gibson, Liverpool.
"Synopsis of British Sea Weeds," by Professor Harvey	Mr. Jno. Michels.

The thanks of the Club were returned to the donors.

The following gentlemen were ballotted for and duly elected members of the Club :—The Rev. F. H. Allen, Mr. C. H. Golding Bird, B.A., Mr. W. A. Green, Mr. A. J. Johnson, Mr. W. Kean, Mr. M. G. Williams.

Mr. J. Slade read a paper "On the Microscopic Characteristics of Cannel Coal, and the method of preparing coal sections for the Microscope." The subject was illustrated by diagrams.

A unanimous vote of thanks was passed to Mr. Slade for his paper.

Mr. Suffolk inquired how Mr. Slade got rid of the remains of the marine glue previous to mounting his finished coal sections.

Mr. Slade said that he had not found it necessary to attempt to get rid of it, the sections were mounted without detaching them. In reply to a question from Dr. Matthews, Mr. Slade said that he believed that coal naphtha would act as a solvent of marine glue.

The President observed that everyone present must have noticed with great interest Mr. Slade's mode of preparing these sections successfully, in which the use of marine glue was a good example of a "little dodge," such as is acquired only by experience. Everyone must have noticed the difficulty with balsam, that from its brittleness it frequently broke up at the last minute and spoiled the specimen. Marine glue was evidently the substance which prevented this catastrophe, and it would doubtless occur to others that marine glue might in other instances also lead to success where balsam had failed.

Mr. W. T. Suffolk said that he had written no paper, but had simply come forward in obedience to a wish that small matters of interest might be brought before the Club. One evening recently, two friends called upon him, and the newest thing in the house being a cheap 1-sixteenth inch objective, they proceeded to try it. Valisneria spiralis was at hand, and was at once placed upon the stage. Unfortunately, however, Valisneria would not work on that occasion, as is sometimes the case, but they discovered something going on in the cells, a kind of movement of rotation which closely resembled something which is sometimes seen going on in Closterium, and which is known as "swarming," that curious movement of particles not more than 1-20th the size of the grains of chlorophyll, rather flattened, and of a bright green colour. He had never seen these granules in motion like this in Valisneria, where the cyclosis was going on. Whether, therefore, it was an action of life, or whether it was an action of decay, was a matter, he thought, which further observation would throw light upon, and he had therefore thought it worth bringing before the members of the Club. Although upon the occasion he had mentioned, a very high power was used, yet he believed a half inch objective might do very well for the purpose, provided black field illumination were used.

Mr. T. Crook said that the circulation described by Mr. Suffolk might be very well seen in a little conferva, the *Spirogyra*. If carefully examined, this movement might be seen going on actively; it was like a number of very minute granules in constant rotation and movement about each other without any circulation like the cylosis in an ordinary plant.

Mr. T. White expressed his obligation to Mr. Suffolk for bringing the matter before the Club; he thought that the question of molecular movement was one of great interest, and one about which all would be very glad to know more. He had observed this kind of motion going on in other things beside plants; some time ago he mounted a female Cyclops in some of the water in which it had been caught, and it remained there for about two years before it broke up. During part of that time, whenever he looked at it, this molecular motion was seen going on inside, and was kept up for about seven months. He was, therefore, inclined to think that it might be the result of the process of decay which was going on.

Mr. Suffolk observed that he was inclined to think that this motion differed from the swarmiug seen in Closterium, because that went on whilst the Closterium was in full vital action.

A vote of thanks to Mr. Suffolk for his interesting communication was proposed by the President, and carried unanimously.

The Secretary announced to the meeting that he had recently received a letter from Mr. T. W. Wonfor, the Secretary of the Brighton and Sussex Natural History Society, announcing that he had, as Secretary of the Quekett Microscopical Club, been elected an Honorary Member of that Society. In the name of the Club he had written to thank Mr. Wonfor for the honour, and had for-

warded him a complete set of the Journals, for which he had received a letter of thanks, and copies of the Society's proceedings. Mr. Wonfor, in his letter, expressed a desire that this interchange might be regarded as something more than an indication that they were associated merely by ties of kindred pursuits, and he requested that it might be made known to the members, that should any of them be visiting Brighton, they would at all times receive a hearty welcome at the Society's Meetings.

The proceedings then terminated with a conversazione, at which the following objects were exhibited :—

Wing of Lasiommata Megæra	by	Mr. W. J. Brown.
Wing of Dragon Fly		Mr. Collins.
Ustilago Maydis, &c.		Mr. Conder.
Licmophora flabellata		Mr. Curties.
Circulation in Spider		Mr. Fitch.
Cellularia Avicularia		Mr. Golding.
Laciniolaria socialis		Mr. Hainworth.
Pleurosigma hippocampus—shown with 1-8th in. immersion lense and prism		Mr. Jackson.
Chelifer cancroides		Mr. Oxley.
Sections of Coal, showing spores and spore cases...		Mr. Slade.
Also for distribution among the members, fronds of Ceterach officinarum	from	Mr. R. T. Lewis.

November 25th, 1870—*Chairman*, Dr. Lionel S. Beale, F.R.S., President.

The following donations were announced :—

"Land and Water" (weekly)	from the Editor
"The Monthly Microscopical Journal"...	the Publisher.
"Science Gossip"	,,
"A Report on the Microscopical Objects found in Cholera Evacuations," &c., by Mr. T. R. Lewis, M.B.	the Author.
A paper "On the Structure and Affinities of the Genus Dicranograptus," by Mr. John Hopkinson, F.G.S.	,,

The thanks of the Club were voted to the donors.

The following gentlemen were ballotted for, and duly elected members of the Club :—Mr. Edward C. Baber, Mr. Herbert J. Barnes, Dr. A. Fyfe, Mr. S. J. Goldsmith, the Rev. Wyndham M. Hutton, Major Lewis Jones, Mr. William Ladd, F.R.A.S., Mr. M. M. McHardy, and Mr. John F. Tate.

Mr. Ackland read a paper, descriptive of a new Neutral Tint Selenite Stage, which was exhibited to the members.

Dr. Matthews said that he was the happy possessor of one of these little instruments, and could testify personally to its great value; he had never seen polariscope objects so harmoniously coloured as they were by its use.

The President proposed a vote of thanks to Mr. Ackland for his communication, which was carried unanimously.

Mr. James Smith exhibited, and described, a new shade for a microscope lamp chimney, which he had designed to obviate the many disadvantages of an ordinary paper shade. It was made of a piece of thin sheet metal, rivetted together in the shape of a hollow truncated cone, and was fitted to slide upon the upright rod at the back of a "Bockett" lamp. A semi-circular piece was cut out of the base of the shade in front, so as to admit of the free use of the bull's-eye condenser, and the inside was coated with whitewash, which gave it a smooth, reflecting surface, and could, when discoloured, be easily renewed in a few minutes.

The President proposed a vote of thanks to Mr. Smith for his ingenious improvement of the "Bockett" lamp, which not only increased the light, but at the same time shaded the eyes, and, he thought, would also intercept some of the heat.

Mr. T. C. White said that nearly every one must have been troubled with lamp shades, and would consequently be very glad to see any improvement in them; the paper shades frequently got scorched and burnt, whilst the metallic chimneys got inconveniently hot—he had himself burnt his fingers badly with a Fiddian's chimney whilst attempting to shift it during the time he was adjusting his microscope to get the proper degree of light through his camera lucida. He called upon a member of the Club one day, and was shown by him a very simple and effective kind of lamp shade, which, he thought, was worth mentioning. It was formed of a piece of millboard, pasted on one side and rolled round a brandy bottle; as soon as dry it was removed from the bottle, was blackened outside, and was then ready for use.

A vote of thanks to Mr. Smith for his communication was then put to the meeting, and carried unanimously.

The President said that he had been pressed to fulfil a promise made some time ago—to offer a few remarks upon the subject of injecting; the difficulty in the matter, however, was that the subject was a very large one, whilst the time at disposal rendered it necessary to condense very greatly; he would, however, do his best to give the members some information as to how they should proceed in injecting the tissues of any of the higher animals. With most persons the idea probably is that an injection is made for the purpose of exhibiting the vessels, and in this respect those made now were scarcely better than what were made many years ago by Leeuwenhock and others; it was, however, a mistake to suppose that it is only of use to show the vessels—it had a much more important use than that in rendering also visible the structure of the tissue themselves, to properly understand which preparation is always necessary. It might be said that the best way to examine a tissue was to see it as it existed naturally very soon after death, but there were many structures which, if only treated in this way, would be totally overlooked. The cornea of the eye, for instance, is the most transparent tissue in the human body, and it might be said that any structure in it must therefore be seen at once; but this would be a terrible mistake, for before you could properly examine it, it must be carefully prepared in a proper manner, and in preparing it you must proceed according to certain principles. In every part of the cornea there are little bodies to be found, and these are disseminated at every possible level throughout its structure, and cannot possibly be demonstrated when the cornea is exhibited in the ordinary way; these bodies have been discovered some time, but new points still continue to be made out. There are also in the cornea other things, there are nerves quite invisible when ex-

amined in the ordinary way, and to see which you must proceed in such a way as to make the nerves more opaque, but at the same time keep the tissue of the cornea transparent. And what is true with respect to the cornea is true also of every tissue of the body. When it is intended to introduce artificial fluids into the vessels of an animal, the best way would seem to be by introducing them through the channels in which the natural fluids would pass during life, and a person is next led to try experiments as to the best fluid to use for the purpose, and the best kind of colouring matter, and it would be found that the best fluid is glycerine. Syrup would do as well in the first instance, but it decomposes, and also is apt to carry with it crystals of the sugar. Glycerine, when introduced into the large vessels of the body, readily diffuses itself into the small vessels, and through their walls into the tissues, in the most complete manner. In all the old preparations, and in the Ger man specimens, nothing could be more beautiful than the appearance of the vessels; but the structure of the tissues was gone and nothing could be learnt of it. In order to make out the most minute points of a texture, it must be immersed in a suitable fluid, and there were some which required that an acid base, or an alkaline base—as the case might be—should be mixed with the glycerine. A colouring matter must also be used, and this must be perfectly suspended in the proper solution. Formerly it was customary to inject with a fluid, in which was suspended an opaque colouring matter, such as vermilion or red lead but the particles of these pigments are frequently too large to go through the capillary vessels, and this necessitated the most careful watching during the process of injection, because if the coloring matter was suspended in glycerine, and the pressure was continued after such an obstruction had taken place, the vessels would break, and the preparation would be rendered entirely useless. A finer coloring matter is therefore needed for the purpose, and it was found that Prussian blue was the best, as it could be obtained in a more finely divided state than any other known substance; no heat was required in its preparation, and it was so fine as to remain suspended in the glycerine so perfectly as not even to require shaking; it was also inexpensive, and could be made for about 6d. per pint. Everyone should make his own fluid, it was easily made from a mixture of Ferrocyanida of potassium, dissolved in water, and glycerine; and perchloride of iron, in water, and glycerine; the one should be added to the other by degrees, and the mixture shaken well each time. It was important to notice that the solution of iron must be added to the Potassium, and not the potassium to the iron. When made properly the solution would hold the particles of blue in suspension so perfectly that they would not subside, and the strength of the fluid could be easily altered by diluting it with water according to the fineness of the work to be done. Dr. Beale then exhibited to the meeting some of the prepared injecting fluid of good quality, and in order that members might practically understand the process, he asked his friend, Mr. Perrin, to prepare one or two animals for the purpose of being injected before them. By proceeding in the manner about to be described it was possible to inject every particle of tissue, no matter what, either of the larger and higher animals, but also of reptiles and others, and a perfect injection of the choroid coat of the eye could be made in the course of a few minutes; the glycerine was also a preservative fluid. Many persons were sceptical as to the value of examinations of injected preparations with higher powers than those obtained by a $\frac{1}{4}$in. objective, but some injections were capable of being examined under very much higher powers, the papillae of the tongue of a frog, for instance, when injected

were so perfect that they would bear examination with a 1 50th inch. He regretted much that many assertions had been made as to the uselessness of these high power injections, and he was quite prepared to produce specimens and to meet anyone—Mr. Huxley if he pleased—in order to put the matter to the test. Mr. Huxley should then make a drawing of the specimen under a 1-12th inch objective, and he would himself make one under a much higher power; he would then ask Mr. Huxley to do the same, and they would then see whether very much more had not been made out under the higher power than with the lower one. It appeared to him to be a most unwarranted statement to say that everything there was to be seen in these preparations could be made out with one of Ross's 1-12th inch objectives; and he thought it a great pity that Mr. Huxley would not come forward and put the matter to the test. In proposing such a trial as he had mentioned, he must make it a proviso, that the specimen to be examined had not been seen before, but that each observer must then see it for the first time; for it was well known that after a person had conned a structure over under a 1-50th in., he could see muc i more in it with a 1-12th inch than he could have been able to do before. He could not himself see at present any limit to the usefulness of magnifying powers, every improvement in which must, he believed, give an increase in results, carrying us on in the way from point to point. Dr. Beale then called attention to a number of coloured diagrams, which were exhibited in the room, to illustrate some of the results obtained by injections, and, in some instances, also the failure of the process from the too great size of the particles of colouring matter employed for the purpose. Another point with regard to the use of injecting fluids was that a number of other processes may be carried out by means of them· He had been in the habit of demonstrating in this way the existence of masses of living matter, and it had been shown that an alkaline solution containing a colouring matter—such as an alkaline solution of carmine —had the power of colouring the bioplasm; it passed through the walls of the vessels, and coloured all the germinal parts, but did not colour the other parts, the striking point being this—that the living matter was coloured, bnt the non-living matter was not coloured. A person who attempted these injections must make up his mind to fail a number of times; he would at length, however, begin to obtain some amount of success after a few trials, and then, stimulated and encouraged by this, he might go on, until by-and-bye he would no doubt obtain some very excellent results. Before proceeding to give the members a practical illustration of the process, he would say a few words with regard to the preparation of specimens to be injected. Very much of the chance of success depended upon the way in which the animal was killed, and upon the time at which the injection was made. It was generally performed some time after the rigor mortis had passed off, because until it has done so the passage of the injecting fluid would be stopped in consequence of the strong contraction of the muscles; but if a person waited until it had passed off (which it did in 12 to 24 hours after death), the most delicate portions of structure would already be decomposed, for decomposition, especially in the summer months, takes place very shortly after death. If, however, the animal was killed suddenly, by shock, and was immediately operated on whilst all the muscles were in a state of relax, the tissues could be most perfectly injected, just in the condition in which they had existed at the moment of life. Dr. Beale then proceeded to demonstrate the process which he had described, by injecting the body of a white rat, which, during the delivery of his remarks, had been killed, and pre-

pared for the purpose by Mr. Perrin. A small pipe having been introduced into the pulmonary artery, and tied round, it was fixed to a syringe, filled with the blue fluid, which was then forced into the artery by the pressure of the hand, and, passing thence into the smaller vessels throughout the body, soon forced out the natural fluids of which it took the place. In about two minutes the feet of the animal begun to turn blue, showing how completely the fluid had pervaded the whole system; and the lung was then removed, and handed round the room for the inspection of the members, who were thus enabled to see how completely successful the operation had been. A frog was next experimented upon, and the injection of the lung was again perfectly successful; after which a second rat was injected, and showed very clearly the complete manner in which the injecting fluid had filled the smaller vessels of the ears, eyes, and tongue. Injected specimens of various kinds—some injected with several colours—were exhibited by means of portable microscopes, which were passed round amongst the members; and after giving a few further practical hints as to cleanliness, pressure, cleansing in cases of extravasation, &c., Dr. Beale concluded his remarks, which had been listened to throughout with the greatest interest and attention, amidst a hearty outburst of prolonged applause.

Dr. R. Braithwaite said that he felt he had now a duty to perform, in which all would join, namely, that of proposing a vote of thanks to Dr. Beale for what he had brought before them that evening.

Mr. T. C. White seconded the motion, and expressed his personal thanks to the president for his kindness in coming forward in the way he had done. The vote of thanks was then put to the meeting and carried by acclamation.

The President having briefly responded, the proceedings terminated with a conversazione, at which the following objects were exhibited—

A new Selenite Stage	exhibited by	Mr. Ackland.
Eggs of Plusia Gamma	,,	Mr. Brown.
Various Greenhouse Insects	,,	Mr. Collins.
Various Foraminifera, from Burn's Pool, Connemara	,,	Mr. Hailes.

Mr. Curteis also exhibited a large series of Mr. Higgin's beautiful Microphotographs, a new portable microscope lamp in case was introduced by Mr. Mogenie, and some specimens of mud from Jamaica was sent for distribution amongst the members by Mr. Adcock.

R. T. Lewis.

Yeast and other Ferments.

By C. A. Watkins.

(Read March 23rd, 1867.)

In this paper I shall endeavour to lay before you some of those chemical changes which take place in certain substances when under the influence of other substances called Ferments. In some of these transformations the microscope shews us that there exists an intimate connection between the processes and the growth of some minute organisms, while in others the changes are purely chemical. The subject, which is of interest alike to the physiologist, microscopist, and chemist, has received great attention from many excellent observers ; nevertheless, very little is known about it, and at present the whole matter is involved in great mystery.

I, therefore, feel considerable diffidence in addressing you on such a subject, and should not have attempted it had I not observed that many writers fall into serious errors when discussing the chemical operations of the Ferments.

I may at once tell you that the matter contained in this paper is perhaps more chemical than microscopical; but the fact is, these two investigations are inseparable if we desire accurate knowledge, and it is impossible to view Ferments broadly, if treated only as a chemical or only as a microscopical subject.

Fermentation is a term applied to various chemical transformations, which certain ordinarily stable compounds, such as starch and sugar, undergo when in contact with a small quantity of an azotised or albuminous substance, which is itself in an active state of alteration. This active substance is called a Ferment, and one of the peculiar properties of such a body is that it receives nothing from, nor imparts anything to, the matter which is undergoing fermentation, but is itself decomposed and destroyed as a Ferment in proportion to the matter fermented, which is gradually split up, or unfolded into two or more substances of simpler composition, sometimes with and sometimes without the assimilation of water.

This unfolding under the action of Ferments is totally different to that chemical change known as Catalysis, which takes place in one substance by mere contact with another, such as the unfolding of Alcohol into Ether, and Water, by contact with Sulphuric Acid; for although the acid causes such a wonderful change, it is not destroyed by the operation, and, consequently, when once the process is set going an unlimited quantity of alcohol may be converted by the original acid.

All the Ferments are highly complex azotised substances allied to Albumen; but while they possess this character in common, they may be divided into two groups—the one being living organisms, as Yeast, and the other substances derived from various organic sources, such as Albumen, Gluten, Casein, Diastase, Emulsin, and a variety of others—all of which decay most rapidly when in a moist state.

The authors of the "Microscopical Dictionary" would "exclude these substances from the Ferments, and desire that the term Fermentation be restricted to those changes which take place only through the agency of living organisms or Fungi;" regarding which, they also say, "A general law appears to prevail throughout the Fungi that their nutrition differs from that of all other plants in depending exclusively on the absorption and decomposition (with the evolution of carbonic acid gas) of organic compounds, therefore consisting of the performance of the operation of fermentatation on the organic matters on which they feed." But as the chemical operations of the Ferments are so similar, notwithstanding the wide difference in their organisation, I consider there would be no advantage in separating them as proposed, as they form a distinct class of chemical phenomena. I have also to observe that it is not true that carbonic acid gas is always given off during fermentation, nor is it proved that it is evolved during the growth of all the Fungi. The Ferments to which I desire to call your attention are—

Mycoderma Vini, or Yeast, which converts Sugar into Alcohol.

Boiled Yeast, which converts Sugar into Gum and Mannite—this transformation being called the Viscous Fermentation.

Casein, which converts Sugar into Lactic Acid and Butyric Acid; this last conversion, however, being attributed to the action of the Vibrio and Diastase, which converts starch into sugar.

I shall have a few words to say on M. Aceti, or the Vinegar Plant as some call it, which, although included by many among the Ferments, is not so considered by chemists, for reasons I will hereafter explain.

When a saccharine solution is left in contact with casein either in the form of fresh curd or cheese, the sugar is slowly transformed into lactic acid, according to the following equation:—

$$\text{Cane Sugar} \ldots\ldots\ C_{12}H_{11}O_{11} + HO = 2\,C_6H_6O_6 \ \text{Lactic Acid.}$$

In this fermentation water is assimilated, but no gas is evolved.

A solution of lactic acid, similarly treated, is transformed into Butyric acid thus:—

$$\text{Lactic Acid} \ldots\ldots\ 2\,C_6H_6O_6 = \underset{\text{Butyric Acid.}}{C_8H_8O_4} + \underset{\text{Carb. Acid.}}{4\,CO_2} + \underset{\text{Hydrogen.}}{4\,H}$$

In this fermentation, both carbonic acid and hydrogen gases are evolved. It is a question not yet answered, whether these chemical changes are induced by mere contact with the decomposing casein which is regarded as the ferment, or whether the minute organisms developed in these solutions are the real ferments living on the matters therein. One thing is quite certain, that in both fermentations living organisms abound, and they cannot grow without chemical changes taking place.

"M. Pasteur considers that a specific ferment is concerned in the production of the lactic acid fermentation, which spreads itself out as a grey substance over the surface of the sediment; and he asserts that this organism when once obtained, and a small quantity added to a solution of sugar, very rapidly converts it into lactic acid, provided the solution contain a small quantity of some nitrogenous substance. When this grey matter is examined by the microscope it is seen to consist of very small globules or very short articulations, either isolated or in threads, much smaller than Yeast, and to exhibit very rapid gyratory motion."

I have not succeeded in obtaining this grey matter, but as the lactic acid fermentation goes on very slowly, and as this season of the year is not favourable for experiments on fermentation, it may not have had time to make its appearance.

In order to observe the organisms which accompany the transformations of sugar, I watched the progress of the lactic acid

fermentation of cane sugar, that of milk sugar by the gradual decomposition of milk, and also the viscous fermentation of cane sugar; for although I have seen no notice of any living organism being concerned in this fermentation, I thought it likely that the viscid ropy matter which is formed therein was probably due to some organic growth.

Now in all these experiments I found that as soon as decomposition commenced, or at least was appreciable, but not until then, organic life was found in all the fluids; that in all cases they appeared on the surface before they were seen in the body of the fluid, and that when first discovered they were not in an active condition, but as the decomposition progressed they became so, and moved through the fluid with rapidity, but those at the surface continued to be the most active. These bodies are species of Vibrio and Bacterium.

The milk used in the experiments was obtained perfectly fresh, and divided into three portions—one containing the cream after the milk had stood 24 hours, the second was simply the skimmed milk, while the third portion was some of the same, with the addition of chalk to neutralise the lactic acid as it was formed. During four days the milk remained sweet, and I detected no organism in any part of it; but at the end of the fourth day the cream had a sour odour, indicating that lactic acid had been formed, and a small speck taken from the surface with a needle exhibited a mass of Bacterium like bodies which, when some distilled water was passed between the glass slide and cover, swarmed through the fluid with rapid and various capers.* On the fifth day the milk had become sour, and exhibited the same active organs, but in the portion to which the chalk was added they were neither so numerous nor so active. On the eighth day fungus spores and mycelia appeared on the surface of the cream, and the same was noticed, but in a lesser degree, some days afterwards on the two portions of milk; but as a considerable amount of lactic acid was formed before these objects made their appearance, I do not imagine they were concerned in the fermentation which was going on.

But it was in the mixture of Boiled Yeast and sugar solution to produce the viscous fermentation that I found these bodies developed most rapidly, for in 24 hours after the mixture was made,

* The motion here referred to is not due to the currents produced by capillary attraction, evaporation, &c.

the fluid was covered with a thin film, which proved to be entirely these organisms packed closely together, so that no motion could be seen until some distilled water was added, when their activity was fully displayed. In the course of a few days the film had become a thick viscid scum, consisting entirely of these minute bodies without a sign of any fungoid growth.

From the fact that these organisms grow most rapidly, and are in the greatest activity at the surface, it appears that air is necessary to produce these results, for in the mixture of milk and chalk from which carbonic acid was given off as the lactate of lime was formed, they were always in smaller quantity, and less active condition: this vessel, too, was covered with a plate of glass, while all the other solutions were covered with paper.

When starch or sugar is transformed* into butyric acid, Vibriones are sure to be found in the fluid, whether they produce this fermentation or not; and lately a most remarkable statement has been published by M. Bechamps regarding this matter. This gentleman asserts that he has discovered that there exist at the present time, in large blocks of chalk taken from a depth of 200 feet from the surface of the soil from a tunnel driven in a mountain, large quantities of microscopic animalculæ, which he has named Microzyma Cetæ; and he also states that if some of this chalk be placed in a saccharine solution lactic and butyric acid fermentation ensue.

Yeast is so well known that its description here is quite unnecessary, and the fact that it converts sugar into alcohol is patent to all. The chemical formula of this change is thus:—

$$\begin{array}{ccccc} \text{Grape Sugar.} & & \text{Alcohol.} & & \text{Carbonic Acid.} \\ C_{12}H_{12}O_{12} & = & 2\,C_4H_6O_2 & + & 4\,CO_2 \end{array}$$

Yeast is supposed to be the conidial condition of Penicillium Glaucum, but much light is required to be thrown on this matter to raise it from its present obscurity.

The yeast cells consist of an outer membrane of cellulin—the

* During the transformations which took place in these experiments, I detected no organism having the slightest resemblance to Yeast; the only fungus being Oidium Lactis, which does not grow in the fluid, and, in my opinion, has no reference to the fermentation. In all the instances in which lactic acid was formed, I noticed only Bacteria or Vibriones, and while I admit that under more favourable conditions of temperature, other growths may appear, I do not consider any of these organisms to be the specific lactic acid ferment.

same material as the cellular tissue of other vegetables—in the interior of which is a highly complex gelatinous substance allied to albumen.

The appearance of Yeast under the microscope varies considerably with its condition; when at rest, that is, when fermentation is arrested, its form varies from globular to ovoid, frequently with an uneven outline, as if the cells were very partially empty; but when they are put into a fresh solution of sugar they swell out, and during active fermentation appear globular or nearly so, and more transparent than before.

When Yeast is added to brewer's wort it increases rapidly, and grows to six or eight times its original quantity during fermentation; the wort being a solution which contains in abundance the elements required for its development, namely, grape sugar and some albuminous substances derived from the malt and hops.

During fermentation these albuminous matters disappear from the solution in proportion to the development of the Yeast, and the sugar also disappears in the same ratio. When the fermentation is complete, we find that in place of the complex albuminous matters in the wort we have simpler chemical combinations, such as salts of ammonia, and in place of the sugar we have alcohol. These chemical changes take place simultaneously; but with this important difference, that the amount of nitrogen in the original wort is reduced by about one-half, while the alcohol and carbonic acid nearly correspond to the weight of the sugar, the remainder being converted into lactic acid, &c., a small quantity of which is always formed during vinous fermentation. But the Yeast consisting almost entirely of albuminous matters, and having increased to several times its original quantity, fully accounts for the disappearance of so large a proportion of the nitrogen from the wort.

Thus it will be easily understood, that Yeast, in order to grow, must be supplied with some soluble azotised matter, such as albumen; and it is as easily proved that it will not grow without.

To ferment 100 parts of sugar, one part of yeast is required; when the fermentation is complete, the yeast is exhausted, and in its place ammoniacal salts and cellulin are found. As the vinous fermentation takes place only during the growth of the yeast, it may be said that it will grow in simple saccharine solutions. In a certain sense this is correct, but such growth is degenerate and exhaustive, and not the healthy growth which increases and multi-

plies, for in such a solution the yeast positively lives on its own substance: this has been proved by Pasteur, in the following manner:—"He took a quantity of washed yeast, and divided it into two equal portions,—one of these was placed in a solution of pure sugar, the other portion was boiled in water, the decoction filtered, and the filtrate added to a similar solution of sugar, to which a very minute quantity of fresh yeast was added. In the first case 12 parts of sugar were converted into alcohol in six days, when the yeast became exhausted. In the second case the liquid became turbid; fresh yeast was formed at the expense of the azotised matter derived from the boiled yeast, and ten parts of sugar were fermented in nine days."

Some years ago, when experimenting on bread making, I was much puzzled by finding that when the yeast was thoroughly washed the sponge did not rise so quickly, nor was the bread so light as when made with yeast as received from the brewery. I have since learned that a portion of the yeast is soluble in water, and that when it has been dissolved out by washing, the yeast is less active; on exposure to the atmosphere, however, it recovers its activity.

Yeast causes a curious and important change to take place when added to a solution of cane sugar, converting it into fruit sugar by causing it to combine with one equivalent of water, during which operation the solution increases in specific gravity. This transformation is attributed to the soluble portion of the yeast; but be this as it may, some of it is evidently destroyed by the process, as a larger proportion of yeast is required to convert cane sugar into alcohol than grape sugar. It is a fact scarcely known to brewers, who use it, that cane sugar cannot be fermented into alcohol; for although when yeast is added to a cane sugar solution the vinous fermentation eventually ensues, it nevertheless does not commence until the yeast, without any apparent change in itself, has transformed the whole of the cane sugar into fruit sugar. The progress of this transformation may be witnessed by polarized light: the cane sugar producing a right hand rotation of the ray=73°, while the fruit sugar causes a left hand rotation of 26°.

I have one more observation to make in reference to yeast. When it has been kept some days, of course, according to temperature, it loses the pleasant smell it had when fresh, and acquires some fermentive properties, which, as far as I am aware, have not received much attention. It is well known to brewers that if the yeast be allowed to stand on the beer for a day or two after fer-

mentation has been stopped, a very disagreeable effect is produced; the beer is not acetified, but the flavour is entirely changed; it is unpalatable, and the brewers call it yeast-bitten.

Now I am not in a position to throw any light on this change; but if stale yeast be examined with the microscope, there will be found interspersed among the ordinary cells a large number of minute globular bodies, which are generally in motion; and I have also noticed a larger proportion of short, straight vibrio-like bodies, than are to be found in yeast during active fermentation.

Whether these organisms produce the disagreeable effects referred to, I am unable to say, and merely point to them as one of the changes which take place in yeast when left to itself.

Diastase is a ferment, which has the property of converting starch into sugar, by causing it to assimilate the elements of water without evolving any gaseous products.

The transformation is represented thus:—

$$\underset{\text{Starch.}}{C_{12}H_{10}O_{10}} + \underset{\text{Water.}}{2\,HO} = \underset{\text{Sugar.}}{C_{12}H_{12}O_{12}}$$

Diastase is extracted from malt by soaking it in water, in which, at moderate temperature, it is soluble; it may be taken as the type of the ferments produced in all germinating seeds—for as all seeds contain starch, which must be rendered soluble in the form of sugar before it can become food for the embryo—so they all contain some azotised matters as albumen, gluten, &c., which are capable of passing into the form of a ferment, allied to diastase.

The action of diastase on starch is so well described in all chemical works—which treat of the vegetable products—that it seems strange anyone should attribute the conversion of starch into sugar, during germination, to any other cause, without assigning some sound reason. Yet, in a popular book by Dr. Carpenter, on "Vegetable Physiology," published a few years ago, he says:— "Starch differs but little from sugar, in chemical composition, except in containing one additional proportion of carbon. When germination commences, oxygen is absorbed by the seed in the substance of which it combines with the carbon that is to be set free from it; and a large quantity of carbonic acid is then given forth again to the air, whilst, in the same proportion, the starch is converted into sugar."

This implies that the conversion of the starch into sugar, and the evolution of $C\,O^2$ gas in germination, are the results of the

same process; but if you will refer to my diagram, you will see that starch does not contain an additional proportion of carbon, as compared with sugar, but that it requires two equivalents of H O to equal it; and that were one or two equivalents of carbon to be oxidized and abstracted, we should not have sugar as the result.

It is a well-known fact that, in germination, the starch is converted into sugar by the diastase, which is probably formed from the azotised matters by the vital action of the embryo. The oxidation of some of the carbon contained in the seed is more likely to be due to the decomposition of the sugar and other matters by the growth of the embryo, the cells of which appear to me to perform chemical functions similar to some of the fungi, for at this period of its growth it must be remembered the vegetable action is reversed, that it is now living on organic compounds and evolving $C\ O^2$ gas; whereas, when it has expanded its leaves to the light and atmosphere, its food must be reduced to simpler forms before it can assimilate it, and it will then construct organic compounds, and decompose $C\ O^2$ gas, eliminating oxygen.

Malt contains about $\frac{1}{500}$ part of its weight of diastase, and as one part of diastase will convert 2,000 parts of starch into sugar, it evidently contains a much larger quantity than is necessary for the conversion of the remaining starch in the grain. This is taken advantage of in various ways by distillers, &c., for the purpose of converting unmalted grain and starch from other sources into sugar.

The action of diastase and other similar soluble ferments is supposed to be instantaneous when the matters on which they act are also made soluble.

As an illustration of this, I will tell you what is done at one of the large distilleries in the North.

Starch and grain are ground into a fine powder, and put into a mash tun capable of holding several hundred quarters, and heated till the starch granules burst, and a thick paste is formed. When at the proper temperature, an infusion of malt is run in and agitated, and in about two minutes the whole of this stiff mass becomes perfectly fluid, the starch being at once converted into sugar by the diastase in the infusion.

In the instances of fermentation I have brought to your notice, I have shewn only the chemical transformations of the matters fermented, these changes resulting in the re-arrangement of the atoms or the molecules of which those matters are built up, thereby giving rise to entirely new structures.

The ferments themselves suffer differently, being always reduced to the simplest combinations.

Looking at the result of a fermentation, it would appear that the ferment and the matter fermented did not enter into combination, but that its transformation is due to the force generated in the decomposition of the ferment with which it is in contact. It is, however, clear that the changes which take place in the two substances are collateral, for the same ferment will produce various chemical transformations of a substance according to the phase of its own decomposition. "Thus diastase, when fresh, converts starch into sugar; if kept for a few days, it converts it into gum instead of sugar; while at another period it converts the starch first into sugar, and then transforms it into lactic acid."

Therefore the transformations always depend on, and are relative to, the peculiar changes which take place in the ferment.

The commercial production of vinegar appears to be due to the agency of one or more microscopic organisms, the mass being called the vinegar plant, which, as I have said, is not regarded as a true ferment by chemists, and for this reason; all the ferments proper, such as I have described, produce the transformations entirely within the solutions, receiving nothing from, nor imparting anything thereto; but the conversion of alcohol into vinegar is a case of simple oxydation, in which the oxygen is derived from the atmosphere, each equivalent of alcohol absorbing four equivalents of oxygen to become acetic acid, according to the following formula:

$$\underset{\text{Alchol.}}{C_4H_6O_2} + 2\,O = \underset{\text{Aldehyd.}}{C_4H_4O_2} + \underset{\text{Water.}}{2\,HO}$$

$$\underset{\text{Aldehyd.}}{C_4H_4O_2} + 2\,O = \underset{\text{Acetic Acid.}}{C_4H_3O_3} + HO$$

In countries where no duty is imposed on the manufacture of alcohol, it can be made into vinegar cheaply and rapidly. The alcohol diluted with water, and a small quantity of some azotised substance added, is allowed to trickle over beech shavings placed in a vat, so arranged, that a current of air circulates freely throughout.

For some days the process goes on very slowly; but the shavings become gradually covered with a slimy fungus, called mother of vinegar, and then acetification proceeds much more rapidly.

Pure dilute alcohol, exposed to the air, undergoes no chemical change; and its conversion into vinegar is undoubtedly due to some

complex action of the growth of the fungus on the matters in solution; but the exact chemical operations of this vegetation are unknown.

Since writing the above, my attention has been called to some observations on this plant by Mr. Slack, (Vol. V., p 2), and published in the "Microscopical Transactions." He states—and I have no doubt of the truth of the assertion—that, "If some of the gelatinous portion of the plant be examined with high powers, it will be found to contain millions of minute bodies, resembling bacteria, some of them not exceding $\frac{1}{16000}$ of an inch in length.

I have recently examined a dilute solution of alcohol, which is being converted into vinegar, and find these bacteria in abundance. They may be seen distinctly when magnified 250 diameters, though a high power must be used to resolve their structure.

The study of these minnte organisms, though very uninviting to the general microscopist, would richly reward any patient investigator—for until we know more of the chemical processes which take place in and through them, the subject of putrefactive decomposition must remain a blank, as it is at present.

The vinegar plant and yeast are said to be different conditions of the same vegetation; the Brothers Tulasne have shewn us that these lower species of vegetation pass through various phases during their growth, each having previously been considered as a distinct plant; and I see no reason why these minute organisms should not produce different chemical combinations at the different stages of their development, since we see, in the higher order of certain plants, that some of their chemical processes are reversed at points of their existence, namely, during germination, flowering, and the ripening of the fruit, when they absorb oxygen and give off carbonic acid to the atmosphere.

In conclusion, allow me to observe, that I am fully aware of having written a paper with a very slender knowledge of the microscopic organisms, whose chemical operations I have discussed; therefore, I hope those parts which I have left in darkness will now receive the light of your experience and knowledge as microscopists. I am very anxious to obtain information concerning the part which those minute vibriones and bacteria play in nature's economy, for there can be no doubt that those remarkable bodies, appearing everywhere, and springing into active existence almost at a moment's notice, must perform some important part in many of the changes which surround us.

Diatomaceous Deposits from Jutland.

(Part 2.)

By F. Kitton.

(*Read January 27th*, 1871.)

In a previous communication, read before the Club on the 24th June last, and published at page 99 of the present volume of the Journal, I enumerated and gave descriptions of a series of forms occurring in these deposits, chiefly those described, or referred to by Heiberg. There remain other forms to be named and described, some of them new, and all interesting, which form the subject of the present paper. Some apology, perhaps, is needed for offering so purely technical a communication to the Club, but the barren facts of science are essentials, without which there could be no generalizations.

1. *Stictodiscus angulatus* (Grunow)—Frustules composed of two dissimilar valves, one convex, the other slightly concave and umbonate; valves disciform, the convex valve with two slight marginal projections at the opposite diameters; markings cellulate and costate; costæ conspicuous near the margin, but disappearing as they approach the centre cellules; radiant between the costæ; scattered at the centre; concave valve without marginal inflations; costæ indistinct or wanting; cellules more scattered; centre with distinct pore, or pseudo-nodule; frequent in the Mors, Fuur and Nykjobing deposits (pl. 13, figs. 1-2).

This elegant little form resembles *S. Kittonianus* (Greville), but differs from that species in the peculiar lip-like projections of the convex valve. The concave valve resembles *Porodiscus nitidus*, of Grev. Trans. Mic. Soc., vol. xi., p. 65, pl. 4, fig. 5, and it is probable the two forms are identical. I have named this species, on the authority of Möller's, "Typen Platte."

2. *Aulucodiscus Jutlandicus* (n. sp., F.K.)—Valve hyaline; processes sub-marginal; furrows distinct; granules radiant; disc not bullate, beneath the processes; deposit Fuur (pl. 13, fig. 3).

This species has not, so far as I am aware, been found in any other deposit than that from Fuur. I am indebted to G. M. Browne, Esq., of Liverpool, for the loan of this species.

3. *Stephanogonia Danica* (Grunow)—Valve in front view produced to a long blunt point; side view discoid, with six or more rays; centre hyaline; spaces between them marked by irregular, anastomosing lines; surface granulate, or rugose; common in the Mors, Fuur, and Nykjobing deposit (pl. 13, figs. 4-5).

I have adopted Herr Grunow's generic and specific names on the authority of the Typen Platte. Although common, I have not been fortunate enough to detect a perfect frustule, and am unable to tell whether the valves are similar. The probability is that they are so, as no valve occurs in these deposits, differing from the one now described, that can be referred to this species. The elegant outline of front view of valve forcibly reminds of the tapering dome of a Turkish minaret.

4. *Trinacria Heibergii* (n. sp., F.K.)—Frustules in series; processes produced; margin of valve convex, turgid, extending beyond surface of valve; central portion of valve umbonate; base of margin with conspicuous, moniliform granules, arranged in series, but becoming scattered and distant as they approach the upper portion; surface of valves marked with small granules, arranged in radiant, curved lines, indistinct or absent as they approach the centre (pl. 13, fig. 6). Mors deposit.

Var margin as in preceding form; surface of valve hyaline, smooth, or with few scattered granules (pl. 13, fig. 7). Mors deposit.

The very singular species I have above described is not uncommon in this material, and I was long inclined to consider it a form of *T. regina*, but the plumose arrangement of the granules, and their small size, and the projecting margins, seem to warrant a separation from that species. The variety with upper surface smooth might easily be mistaken for the marginal part only, but careful focussing will detect the presence of a thin hyaline surface, sometimes marked with a few scattered granules.

5. *Triceratium maculatum* (n. sp., F.K.)—Valve with slightly concave margin; granules small and close at the centre, larger and scattered as they approach the sides; margin with short, conspicuous costæ; centre of valve with three or more irregular, radiating lines; deposit Nykjobing (pl. 14, fig. 14).

This diatom occurs in the Nykjobing deposit only, it resembles *T. venulosum*, of Greville, in Trans. Mic. Soc., but on careful comparison it will be found to possess many well marked differences.

TROCHOSIRA (nov. gen., F.K.)—From Τροχος, a wheel, and Σειρα, a chain. Frustules in filaments connected by one or more central processes; valves discoid, convex, smooth, or faintly striate margins.

6. *T. mirabilis* (n. sp., F.K.)—Frustules connected by a long spine produced from the centre of the valve; valves in front view smooth, with a central nodule (base of spine) pl. 14, figs. 8-9, Mors, Nykjobing, and Fuur deposits.

This very singular form requires to be seen in a living state to fully understand its structure. The space between the two opposing valves, and perhaps the whole of the frustule, was covered with a non siliceous investing membrane.

7. *T. spinosus* (n. sp., F.K.)—Frustules in filaments connected by five or more short processes; valves in front view convex; central portion flat or truncate (a section of valve resembles a short truncated cone), the spines produced from the margin of the central portion; side view of valve discoid, five or more sub-central nodules (bases of spines), margin faintly marked with short striæ (pl. 14, figs. 6-7), associated with the preceding.

8. *Sceptroneis gemmata* (Grunow)—Frustules bacillar; margin with distinct, pearl-like granules connecting zone; finely punctate; puncta arranged in longitudinal lines; valve narrow, gradually tapering to the narrow, rounded apices; costate costæ broad, nearly reaching the centre of valve (pl. 14, figs. 4-5), common in the preceding deposits.

I have named this species on the authority of the Typen Platte; it resembles *S. caduceus*, of Ehr., in its markings, but differs much in the outline of side view. I have seen it forming a short series of five or six frustules.

The forms described and figured in this and the preceding paper are characteristic of these deposits; many other species occur in more or less abundance, most of which have been described and figured by various observers as occurring in various fossil deposits or recent material.

The following is a list of the most prevalent :—

Stephanopyxis (Creswellia) sp.? (p. 14, fig. 15).
Coscinodiscus stellatus*
„ radiatus
„ Oculus Iridis
„ concinnus ?
Actinocyclus Ralfsii, rare
Actinoptychus senarius.
Goniothecium ? ? (pl. 14, figs. 1-2-3).
Syringidium ? ? (pl. 14, fig. 10).
Hemiaulus ? ? pl. 14, fig. 11).

The three last-named forms I do not describe, and refer them to the respective genera with great doubt; figs. 12-13, pl. 14, is probably not diatomaceous; it is, however, so remarkable I thought a fig. of it might be desirable.

The Protozoa are represented by two or three species of *Polycystina;* and sponge spicules.

EXPLANATION OF PLATES.

PLATE 13.

1. Stictodiscus angulatus S.V.
2. Stictodiscus angulatus F.V.
3. Aulucodiscus Jutlandicus.
4. Stephanogonia Danica S.V.
5. Stephanogonia Danica F.V.
6. Trinacria Heibergii.
7. Trinacria Heibergii var.
8. Trinacria Heibergii, section of valve.

PLATE 14.

1. Goniothecium ? ?
2. Goniothecium ? ?
3. Goniothecium ? ?
4. Sceptroneis gemmata F.V.
5. Sceptroneis gemmata S.V.
6. Trochosira spinosus F.V.
7. Trochosira spinosus S.V.
8. Trochosira mirabilis F.V.
9. Trochosira mirabilis S.V.
10. Syringidium ? ?
11. Hemiaulus ? ?
12. Undescribed form (not diatomaceous ?)
13. Side view of ditto.
14. Triceratium maculatum.
15. Creswellia sp. ?

× 400 diameters.

* According to the Typen Platte, this is the Symbolophora Trinitatis of the Microgeologie, an opinion with which I do not concur.

Sections of Hard Tissues.

By T. C. White, F.R.M.S.,

(*Read December 23rd*, 1870.)

One of the easiest preparations that young microscopists can try their " 'prentice hand " on is the making of sections of the hard tissues, and it is one attended with much interest in watching the gradual development of structure where all was dark and opaque before. It is not my intention this evening to dwell upon making sections of such tissues as wood, horn, or hair, and such like structures, but to speak more upon the making of sections of teeth for microscopic examination, as the mode generally adopted in this case is applicable to such substances as shell of various kinds, and such hard tissues as stones of the plum and peach, &c. It has been recommended by writers on this subject that the section after having been cut by a fine saw and reduced by a file, should be further rubbed down on a hone, this plan has been attended with very good results in the hands of some, but I wish to bring before the members this evening the plan I have adopted for some time, and which I am rather favourably inclined to. I proceed in the ordinary way to make a thin section by means of the saw and file, reducing my section to the thinness of an ordinary card, then, instead of using a hone, which I find rather a slow process, I place my section between two plates of ground glass, with plenty of water, and by rotating the upper glass upon the second, I succeed in getting the finest and most transparent sections. After using these plates some time the grain of the glass gets worn away, and thus, if you keep your glasses, you may get every degree of coarseness required, the oldest pieces putting a final polishing to your section. If you desire to expedite the first part of the grinding, a little finely powdered pumice stone sprinkled between the plates will greatly assist the rapidity of the action of the glass, especially in cutting such tough shells as that of the crab and lobster. I have placed under the microscope this evening the lower jaw of a weasel cut in this manner, and still

retaining its teeth. In this case I soaked the jaw in such a way as to saturate it with Canada Balsam in Benzole; this, when it had evaporated, filled every interstice with hard balsam, and so retained the teeth in position while the grinding was performed.

I wish now to speak of the various appearances observed in sections of the teeth, as it may prove useful to many here who may feel inclined to make sections of some sent here for distribution this evening.

The tooth most easily worked is that removed from a child, a temporary tooth; the structure approaches most nearly to the normal condition, and such a section will present the following appearance: in the centre, a cavity occupied in the recent state by a soft fleshy mass—what is popularly known as the nerve, but in reality being composed of the minute ramifications of the nerve, vein, and artery, supported by fibrous tissue; on the outer side of this, and making up the greater part of the tooth, is the dentine, or the tooth bone proper, as it may be termed; this consists of a number of fine tubes, about $\frac{1}{10000}$ of an inch in diameter placed closely side by side, and radiating everywhere at right angles to the walls of the central pulp cavity. Covering the upper part as a protection, may be seen the dense, almost inorganic enamel, whose crystalline prisms stand vertically to the surface of the dentine, and covering that part of the tooth which protrudes through the gum. On the lower part of the fang, and thickest near the apex of the root, the cementum will be found with its lacunæ and straggling canaliculi. Such, roughly, is a sketch of the appearance presented in a healthy, well-developed tooth; but age and various disturbing causes will interfere with or alter the appearance here described, and I shall now attempt to give you a description of the changes from the normal condition which are usually met with.

Some teeth are obliged to be removed, especially in old age, on account of getting loose and barely hanging in the mouth; these teeth seldom show any decided appearance of decay, and are generally extracted entire.

Upon making a section of such a tooth as this, the apex of the tooth will be found transparent like horn or tortoiseshell; such teeth are to all intents and purposes dead members, and hence the loosening. The dentinal tubes are filled up, and become consolidated by a deposition of calcareous matter, and should the tooth be ground down on its surface by mastication, the upper part of the pulp

cavity will be found filled with a secondary dentine, presenting some resemblance to the regular dentine, but with the tubes more sparsely distributed, and curving irregularly through the mass.

In fangs of teeth that have been painful for some time, attended by much inflammatory action, fresh bone is added to the cementum, and what is termed an "exostosis" is produced; such a one as this I have placed under the microscope, where the layers may be observed succeeding each other in the order of the inflammatory exacerbations.

In some teeth presenting a rough, ridgy, and honey-combed appearance, the dentinal tubuli are found traversing large globules of the dentine, as if originally the dentine had been put together in large globules which had never become fused, but had left interspaces between each globule. This form of dentine is generally found in teeth of delicate children where some illness has interfered with the process of deposition, and hence the imperfect calcification. These teeth are best mounted by laying the section on a tolerably stiff layer of balsam, and when thoroughly embedded in it, cover it with balsam almost as stiff as that placed under it, that no absorption may take place which would render the interspaces too transparent and invisible.

On Papers for the Club.

(*Read August* 26*th*, 1870.)

In looking over the past records of the Quekett Microscopical Club nothing has so often forced itself upon my attention as the note "Papers Wanted," and no greater difficulty presents itself now than that want of papers "on topics of interest, that discussion of doubtful points," which will be found enumerated as among the objects for which the Club was founded. From whence, then, arises this want? How shall this difficulty be surmounted?

First, I would ask, why do members hold back their communications? For all must have some they could make. What do they consider is required of them? And here let me say I believe we strike at the fountain head of all that reticence so marked of late at our meetings. I believe the feeling, if not openly expressed, is at least tacitly felt, that the Quekett Microscopical Club is a scientific society, and accordingly that communications made to it must

possess that startling and novel character which mark the papers read at societies whose aims are the elucidation of deeper mysteries of natural science than come within the scope of microscopy. Now here, I conceive, the root of the difficulty lies, a root springing up into that gloomy shadow obliterating the "*cheerful converse*" which should characterise the meetings of men whose tastes and pursuits are of a kindred nature.

Allow me then, in the first place, to assert, on behalf of the founders of the Club, that it never was their intention to aim at being a scientific society, or to place the Quekett Microscopical Club on the same level as that occupied by the scientific societies of Great Britain; it was founded for a different purpose, and was based more upon the social assistance it renders in working out all that appertains to the microscope than the scientific work it accomplishes. Let members, then, disabuse their minds of this lofty imagination, if they harbour it; let them content themselves with the practical, social, and valuable work they have performed and are destined still to perform, and not be like Icarus of old, who, soaring too high, melted the wax of his wings, and ended in an ignominious and fatal descent.

Now, what is the nature of the papers required? 1st, *they need not be long*. We are all, I suppose, men of business, and not men of leisure; and, therefore, it would of necessity be an obstacle of considerable importance were we required to fill up the time of the Club by the reading of a paper of half-an-hour's duration. If a man has a subject at his finger's end he can easily throw it together in a short and condensed form, without sacrificing its integrity, therefore I would advocate *short* papers. 2nd, *What should be their subjects?* And here we enter upon a wide field, for it embraces nearly the whole realm of nature; but there are without doubt in the Club men who have worked in each or all of these departments, and who are competent to tell us of the results of their enquiries in these several departments; they may not be able to tell us any *startling* facts, but on the other hand, the probability is that they could acquaint us with a great deal that we were not aware of, or at least they could corroborate the investigations of others. And here I would urge upon the attention of the members the value of *systematic* work. The path of the microscopist lies through a vast plain of interesting facts, but the temptation besets him at every step to turn aside from the straight path to

cull objects of beauty or of interest, which often lead him so far from the path that he loses himself in the bewilderments of desultory collection and dilettanteism. If this should be the ending, the wondrous perfection of our instruments is wasted—one might almost say prostituted—and they become as expensive but worthless toys. Such work can leave a world no better than it found it. A life spent in such pursuits cannot leave its mark behind it; it is the style of the butterfly, not of the bee. I would suggest, therefore, that each member, according to his taste, should select one or two subjects for especial investigation; let him truthfully and impartially follow it out, carefully recording every change, and if possible making *faithful drawings* of every change. The collecting of a cabinet of slides is only of secondary importance to a faithful drawing from a reçent specimen, for slides, mount them as you will, must undergo change, and that change, however slight, detracts from the truth of the subject; and who shall say how important a clue we may lose in unravelling the delicate life history of a tissue, for instance, by reason of contraction or expansion, by coagulation or dissolution in the media employed to mount it. Work undertaken in this manner, would do more in a short time to advance the position of the Club than any inflated notions or wishes to rank as a scientific society, if such are entertained. We have the reputation of being a hard working and practical society; let us add to this a systematic course of work, and then, if the departed spirits take an interest in things on earth, there is one who will rejoice in the army that is named after him. *Now, what form should the papers assume?* Their style need not be laborious, but a plain, simple statement of facts, taking care that any *doubts* in the writer's mind are freely confessed, for by this means discussion will be provoked, and the contact of minds will do much to elicit the truth by the thorough ventilation the subject will undergo. Papers such as these will always be welcome, not that papers full of laborious and exhaustive research would be excluded. These would be the exception, and not the rule. Ask the authors of those exhaustive treatises that we have had read here, and they will bear out my assertion that they were not their first productions. Such a paper as "The Geographical Distribution of Mosses," or that on "Microscopic Moulds," and others read here, were the results of long and systematic work; yet one of those gentlemen, in the earlier days of the Club, gave a simple

paper, entitled "Work for the Microscope;" other papers I find recorded, such as "Manipulation with Canada Balsam," and such papers now would be most acceptable, giving the author's own experience of the use of the various mounting media and methods of mounting, with all his difficulties and failures, openly, plainly, fearlessly confessed.

Again, I would suggest that much remains to be worked out in special departments of microscopical science, and materials for very valuable papers may be gathered from the study of microscopic comparative anatomy, by which I mean that a comparison of the same organ in various insects would prove highly interesting and instructive. Taking, for instance, the rectal papillæ of the blow fly, it would be very interesting to follow out the rectal papillæ in other insects, and to illustrate the subject by drawings and preparations. Again, the development of insects, the metamorphoses they undergo in their earlier stages of growth; but I need not enumerate the many ways in which systematic work of that kind might be carried out. A fresh fact in Physiology, well substantiated, will leave its mark behind. Observations the most simple, if authentic, will add another brick to that beautiful edifice of truth which honest observers are combined to erect.

Again, I would add a word of encouragement to the younger members among us. Do not think because you are young and inexperienced that if you speak up at our meetings you will be "snubbed." No such thing. The men who form the Quekett Microscopical Club are not made of such stuff as would snub a younger brother. I can answer for that from my own personal experience; and your very questions would draw out valuable information from others—information that could not be embodied in a paper, and which would be welcome to many amongst us.

Then, again, I would suggest to absent members the desirability of their contributing to the information of the Club. A large proportion of our members are resident in the country; they doubtless have many opportunities for systematic work. Many, probably, have made some special branch of microscopic science their study. If they will throw the results of their observations together in a paper, the Committee will gladly accept and take charge of their contributions.

PROCEEDINGS.

December 23rd, 1870—*Chairman*, Dr. Lionel S. Beale, F.R.S. President.

The following donations to the Club were announced:—

" Land and Water" (weekly)	from the Editor.
" The Monthly Microscopical Journal"	the Publisher.
" Science Gossip,"	"
1 Slide	Mr. Bennett.
50 Slides	Mr. M. C. Cooke.
2 Slides	Mr. Jackson.

The thanks of the Club were returned to the donors.

The following gentlemen were ballotted for and duly elected members of the Club:—Mr. Robert William Atkinson, Mr. John Childers Crisp, Mr. George M. Dawson, Mr. William Alfred Duck, Mr. John Charles Goldsmith, Mr. Edward Histed, Mr. Robert King, Dr. G. W. Royston Pigott, M.A., and Mr. Joseph Alfred Smith.

Mr. T. C. White read a paper upon "Making Sections of Hard Tissues."

The thanks of the Club were unanimously offered to Mr. White for his paper.

Mr. James Smith inquired whether Mr. White obtained the sections sufficiently fine to enable them to be mounted without polishing, also whether the sections were ground on both sides at once.

Mr. White said, in reply, that he placed the sections loose between the plates of ground glass, and both sides were ground at the same time; by using plates of glass which had been much worn, a beautiful polish could be given to the sections, which could be transferred to a slide and mounted in Canada balsam. If, however, the balsam was too hot there was great danger of the specimen being cracked by the heat.

Dr. Lionel Beale said that Mr. White's process was certainly a great improvement upon the ordinary method of making sections of bone and other hard tissues. He could recollect the time when sections used to be ground down upon the slate, and the finger was employed for the purpose of holding the specimen. When a portion of the cuticle had been ground away your own sensations told you that the process was completed. There was one part of the plan, besides that which had been mentioned, which needed to be considered; for, in addition to ascertaining the character of the hard texture, it was very desirable to find out also the anatomy of the soft tissues which were found immediately in contact with the hard structure. To prepare sections which would properly show both together was a problem of some difficulty, but it

might be done. The ordinary process of grinding was no doubt necessary for obtaining sections of considerable extent, but it was not adapted for making sections of the soft tissues in contact with the hard ; as, for instance, of the soft dentinal pulp as well as of the hard dentine in contact with it. By the ordinary method the grinding either entirely destroys or obliterates the structure of the soft pulp, so that it is found that a section of the pulp, with the dentine in contact with it, as in the recent state, cannot be made successfully in that way. It was not, however, generally known that these hard textures might be softened by soaking them for a long time in glycerine ; bone could be softened by soaking it in glycerine for twelve months, and to such an extent that it could be cut with a sharp knife with the greatest ease, so that sections could thus be obtained sufficiently thin to be examined with a 1-25th inch objective, and under this power much more could be learned with regard to the minute structure of such specimens than under a lower power. In the case of the stones of fruits, in order to make out their structure it was absolutely necessary to obtain sections in the recent state, and these must be *cut* and not obtained by grinding, which would cause the complete destruction of the texture, if it was in a growing and imperfectly formed state. Another mode of great practical utility in investigating the structure of hard textures is to soften them by soaking in glycerine, to which has been added some substance which will act as a solvent of the hard portions of the tissue. By adding a little hydrochloric acid to the glycerine (four or five drops to the ounce) bone could be very readily softened, and by prolonging the action it became possible to make out exactly the order in which the calcareous matter had been deposited. When a small quantity of the calcareous matter had been dissolved away, you could cut thin sections with a knife without difficulty. Acetic acid was also a valuable agent for this purpose. If it was desired to examine the nerve fibres in hard tissues, such as teeth, in which they would be completely destroyed by the ordinary method of investigation, this process might be adopted with advantage. If soaked for some time in a mixture of glycerine and acetic acid it would be found that the acid would soften the hard texture, whilst the glycerine would preserve the nerve fibres intact, and sections could be cut with a sharp knife with facility, and in any direction that was desired. These were some little practical points which he had found useful in making thin sections of hard tissues. Those who attempted these methods must be content with sections of small extent only, as large ones could not be nicely cut with a knife. This, however, was a matter of not very much importance, because if a person made out what might be termed the geography of a large specimen obtained in the way recommended by Mr. White, he could easily make out the minute structure by means of small sections cut in the manner described. As a study for young microscopists, there could hardly be one more interesting than that of the development of the hard stones of fruit, or the hard shell of a nut, or a walnut. Mr. Quekett and others had perhaps ascertained all that was to be demonstrated concerning the structure of the dried fully formed shells which had been ground down to thin sections, but a vast deal had yet to be learned as to the manner in which those hard tissues were formed during development. He was quite sure that a great deal might be done in this branch of investigation, and he strongly recommended the subject to the attention of members of the Club.

Mr. White said that he could fully corroborate all that Dr. Beale had said. After using glycerine and acetic acid, as recommended, the tooth became so

soft that a section could be cut off quite through the fang, and showing the dentinal tubes perfectly. He had been working at the subject for a long time, and had frequently rendered a recent tooth so soft by soaking it in glycerine and acetic acid, that he could shave off a thin slice with a penknife, and in some cases the tooth was rendered so soft that he could draw out the contents of the dentinal tubes attached to the pulp or nerve of the tooth.

Mr. Ruffle said that if any gentleman wished to have some teeth to experiment upon, he could supply them, as a quantity had been placed in his hands for distribution.

The Secretary read a letter describing a new slide for opaque objects. The slide was made of wood, with a cell sunk in the centre, over which a cap of copper tightly fitted, covering in the object effectually from dust, &c., when not required for use, and enabling it to be seen without a covering glass when the cap was removed. Specimens of these slides were placed upon the table for examination.

The proceedings terminated with a converzazione, at which the following objects were exhibited :—

Transverse Section of Beech	by Mr. M. Burgess.
Pygidium of Chrysopa perla	by Mr. Conder.
Gemmæ of Blasia pusilla	by Mr. Jackson.
Section of Lower Maxilla of Weasel ...	by Mr. T. Charters White.

A quantity of miscellaneous objects, unmounted, were presented for distribution amongst the members by Mr. D. E. Goddard and other friends.

January 27th, 1871.—*Chairman*, Dr. R. Braithwaite, F.L.S., &c., Vice President.

The following donations were announced:—

"Land and Water" (Weekly)	from the Editor.
"The Monthly Microscopical Journal"	,, the Publisher.
"Science Gossip"	,, ,,
"The Popular Science Review"	,, ,,
"The American Naturalist"	in exchange.
Mr. McIntire's paper, "Notes on the Minute Structure of Insect Scales" (2 copies)	from the Author.
A paper "On the discrimination of Fibres in Mixed Fabrics," by Mr. John Spiller...	Mr. W. T. Suffolk.
6 Slides of Diatoms	Mr. Curteis.
18 Slides of Diatomaceæ	Mr. Hardman.
3 Slides of Funaria hygrometrica	Mr. A. Smith.

The thanks of the Club were voted to the donors.

The following gentlemen were ballotted for and duly elected members of the club :—Mr. Thomas Forshaw, jun., Mr. Augustus De Souza Guimaraens, Mr. Henry Jefferson, Mr. William B. Kesteven, F.R.C.S.

Mr. M. C. Cooke read a paper by Mr. F. Kitton, of Norwich, entitled "A Further Examination of the Jutland Deposit of the Island of Mors."

The Chairman said he felt sure that all would join with him in a cordial vote of thanks to Mr. Kitton for his interesting paper ; they would also doubtless

feel much satisfaction on hearing that a diminution of species was aimed at rather than an increase in them. Not only in this instance, but also in biology, botany, and other branches of science, the multiplication of species had become very inconvenient, every little variety was now called a species, which not only greatly increased the number of names which had to be remembered, but also added much to the difficulties of classification. Great service might be done to science by reducing the number of synonyms, &c., bringing them down to their regular types. A vote of thanks to Mr. Kitton for his communication was carried unanimously.

The Secretary, after calling attention to the subjects of papers announced for the next meeting, observed that few fields of research were more interesting than micro-entomology, and suggested the study of the anatomy of the spider as affording abundant scope for the researches of any members who desired to enter into a subject which could not fail to be both useful to themselves and to science, as very much had yet to be learnt concerning these creatures.

Mr. M. C. Cooke said that some time ago he was on a visit to a medical friend of his, and then enjoyed two or three hunting expeditions after spiders. His friend took very great interest in them, although he had not done much that season, because there was nobody else to go with; he was, however, remarkably expert at catching them, and taught him very soon how to catch them quickly. His attention had been chiefly directed to the palpi, and of these he had a large collection of mounted slides; and as he was mounting a set of them he intimated that if the Quekett Club would accept them he should be happy to present them to the cabinet. Any doubts on that point were at once removed, so that before long members would probably have an opportunity of examining this collection for themselves. Most of the members were probably aware that the palpi of the female spiders were of small size and were very much alike, but those of the males were much larger, and differed very considerably, not only in different genera of spiders, but also in the different species of the same genus. This was so marked that the specific characters of spiders were greatly strengthened by comparing the difference in the palpi of the male insects, and persons who were well acquainted with the subject could even decide to what species a spider belonged by merely examining the palpi alone. The way in which his friend mounted the palpi was very simple: after taking them off, they were soaked for a short time in liquor potassae, then they were washed to clear them from the alkali, and were afterwards placed upon a glass slide and flattened out by pressure. It might be objected to this method that it did not exhibit them naturally as in the living state; certainly it did not, but they were extended and spread out by the pressure in a manner which enabled them to be very readily examined in all parts. The method adopted in hunting for the spiders was by turning over stones, bricks, tiles, &c., and there was hardly one beneath which a spider was not found. His friend was provided with a number of pill-boxes, and when he catches a spider it is immediately popped into one of them, and then he afterwards chloroformed and dissected them.

The Chairman said he was very glad to have the opportunity of congratulating the members of the club on the promise of this collection of the most wonderful parts of a spider; he had often, even when a boy, been struck with their curious nature, and it was now known that they took an important part in the sexual process. To those members who were desirous of studying the subject, he would recommend Blackwall's work on spiders as being the one in which they would find the fullest information.

The Secretary reminded the members that Blackwell's splendid Monograph on Spiders, to which Dr. Braithwaite had referred, was in the library of the Club.

Mr. Guyton exhibited and described a new portable microscope lamp, which had recently been brought out by Mr. Fiddian; it was ingeniously contrived to pack into a brass case, which also formed its stand when in use; he also showed one of Mr. Field's new dissecting microscopes, which had on a previous occasion been described to the members.

Mr. J. Michels introduced to the notice of the members of the Club a cheap, light, and portable stand and body, to which any ordinary eye-piece and objective could be readily fixed. The body—which was of pasteboard, having a brass nosepiece at the end, screwed with the Society's thread—was attached to a tripod mahogany stand, the whole weighing only a few ounces, and costing not more than seven shillings. He had designed it thinking that something of the kind was required to obviate the necessity for bringing heavy instruments to the Club when anything had to be exhibited.

The proceedings terminated with a conversazione, at which, in addition to the microscopes, &c., above described, the following objects were exhibited:—

Spiracle of Dytiscus	By Mr. J. Michels.
Pollen of Cobea scandens	By Mr. Conder.

February 24th, 1871—*Chairman*, Dr. Lionel S. Beale, F.R.S., &c.

The following donations were announced:—

"On the Structure and Growth of the Tissues and on Life" (a course of 10 Lectures)	from Dr. Lionel S. Beale.
"Disease Germs, their supposed Nature"	
"Protoplasm, or Life, Matter, and Mind"	
"Disease Germs, their Real Nature"	
"Illustrations of the Salts of the Urine, Urinary Deposits and Calculi, including the Structure of the Kidney in Health and Disease, &c."—with seventy plates...	
"Kidney Diseases, Urinary Deposits and Calculus Disorders, their Nature and Treatment" (3rd edition)	
"Archives of Medicine," Vol. 5, No. 17	
"On Medical Progress. In Memoriam, R. B. Todd"	
Descriptive Catalogue of Microscopic Specimens exhibited at the President's Soirée of the British Medical Association. Oxford, 1868 ...	
"Paper on the Structure and Formation of the so-called Apolar, Unipolar, and Bipolar Nerve-cells of the Frog"	
"Paper on the Ultimate Arrangement of the Biliary Ducts, and on some other points in the Anatomy of the Liver of the Vertebrate Animals"	
"Science Gossip"	from the Publisher.

"Land and Water" ... ... ,, the Editor.
"Transactions and Proceedings of the Botanical Society of Edinburgh." ... ... in exchange.
"The Monthly Microscopical Journal" ... ... from the Publisher.
"The American Naturalist," for Jan., 1871... ... in exchange.
20 Slides of Spicules of various Gorgoniadæ ... from Mr. A. C. Cole.
3 Slides of Ancient iridescent Glass, from the Temple of Venus, Cyprus... ... ... ,, Mr. R. T. Lewis.

The thanks of the Club were unanimously voted to the donors.

The following gentlemen were balloted for and duly elected members of the Club :—Mr. Matthew Hawkins Johnson ; Mr. William Henry Thornthwaite, jun.

Mr. J. R. Leifchild called the attention of the meeting to the subject of fossil wood, which had greatly interested him for many years, and of which he exhibited a series of 23 specimens, which he considered to be both historically and intrinsically interesting. They were, he believed, some of the first specimens ever cut into sections as microscopic objects, having been prepared by Mr. Saunderson, of Edinburgh, a lapidary not much known to fame, but who was the inventor of a method of cutting these sections so thin as to allow of the passage of light through them. They were cut for the better-known Mr. Nicol —the inventor of the Nicol prism—and were 23 in number. A fossil tree was discovered in 1826, at Craig-Leith quarry, near Edinburgh, lying slopingly in such a manner as to appear to cut through several beds of sandstone of the carboniferous series; a fact, which, at the time of its discovery, gave rise to several geological disquisitions. It was further exposed in 1830, and in 1831 a supposed branch being uncovered Mr. Nicol was then giving his attention to the subject of fossil woods, and employed Mr. Saunderson to cut the specimens alluded to, and amongst which were the four sections now exhibited, cut from the Craig-Leith tree. The tree was now altogether gone, so that no more sections could be had, and the branch was also gone. A few years afterwards Mr. Henry Witham, of Lartington, near Durham, published a useful book on fossil woods, which contained some illustrations of sections of the Craig-Leith tree, and other trees or portions found in the North of England, and of which the sections now placed before the members were specimens. Mr. Witham did not appear to know much about the species to which the Craig-Leith tree belonged, and it was called *Pinites Withami ;* it is now recognised as Dadoxylon. In studying these fossil woods, the changes made in nomenclature caused some difficulty and required research. The sections, as microscopic objects, were very fine, and somewhat interesting, as illustrating the minute structures of the Coniferæ. Mr. Nicol was frequently able to determine the character of the wood by the examination of sections showing the arrangement of the disc, bearing woody tissue. Since that time the study of fossil woods had very much advanced, but he thought that Mr. Nicol's name ought to be associated with it, because he was the first man who really gave careful microscopic attention to the subject. One of the specimens upon the table possessed a particular interest – it was called by Witham *Anabathra pulcherrima*, but was, in reality, a stigmaria – the same root-like plant as is found under clay beds in many coal deposits, with the sigillaria above them. This specimen of stigmaria showed very clearly the nature and structure of this tree. Recently the microscope had been applied to the examination of other plants found in our coal fields. Mr. Carruthers, Professor Williamson, and others, had given much attention to this subject, and the result would doubtless be, that in a few years they would possess a far more accurate knowledge of the internal struc-

ture of coal plants than was ever expected by such a man as Mr. Nicol. There was in the British Museum a large and interesting collection of fossil woods, as well as a considerable number of Mr. Nicol's sections. Mr. Leifchild further illustrated the subject by reference to some sketches of wood sections, and concluded his remarks by a humourous account of what he termed the Pursuit of Botanical Knowledge under Difficulties, whilst endeavouring to obtain some further information upon the subject.

A cordial vote of thanks to Mr. Leifchild, for his interesting communication, was proposed by the President, and carried unanimously.

The Secretary read a paper by Mr. W. H. Furlonge, "On the Anatomy of the Flea;" also a note from the author, explaining that in consequence of being obliged to go to Ireland he was unable to make some alterations and corrections in the MS., and asking permission to do so before the paper appeared in print.

The President moved a vote of thanks to Mr. Furlonge for his paper, and also that an opportunity be afforded him of modifying some of the opinions therein expressed, as requested in his letter.

Both propositions were at once cordially assented to, and carried unanimously.

Mr. B. T. Lowne spoke at some length on the anatomy of the flea, and differed considerably from Mr. Furlonge's conclusions, although he thought most of the descriptions were fairly accurate. Mr. Lowne chiefly objected to the idea that the organ behind the eye is an organ of hearing; he thought Mr. Furlonge's evidence on that point was entirely imaginary. He also stated that Mr. Furlonge was quite wrong about the sacs in the tarsi. Mr. Lowne said if a flea be killed by chloroform and immediately immersed in glycerine and viewed by reflected light the whole tracheal system appears as if injected with mercury. The sacs in the tarsi so viewed are evidently merely ordinary tracheal sacs such as abound in the stag-beetle and in many other insects. The speaker was of opinion that Mr. Furlonge had mistaken the tendon of the last tarsal joint for the main tracheal tube of the limb, and hence his assertion that he could not trace the communication between it and the sac. Mr. Lowne further stated that he had isolated the tracheal tube, and found the sac in question to be a mere tracheal enlargement without any trace of contractile walls, but marked by the ordinary spiral fibre. With regard to the contractions of the sac, the speaker stated that they were due to a disturbance of the other respiratory organs. In support of this view he stated that if a flea be examined alive without subjecting it to pressure the sacs in question do not exhibit any contractions until chloroform is administered to the insect, but that during recovery the contractions described by Mr. Furlonge always occur. He examined a living flea by surrounding it with cotton wool loosely, so that it remained entangled in the fibres when in the live box. Mr. Lowne ascribed the pulsation in the sacs to the withdrawal of air from them during the inspiratory dilation of the thorax and abdomen, the valves of the spiracles remaining closed, instead of opening in the normal manner. He thought that any injury or pressure would be liable to act on the nervous system, and produce a similar result. Mr. Lowne hoped members would try the simple experiment indicated, and they would then be convinced that the contraction of the sacs was an effect and not a cause of the circulation of air, and likewise that it did not occur under normal conditions. Mr. Lowne then drew attention to the relation of the tendon moving the last tarsal joint with the sac, and stated that the contraction of the muscle moving the tarsus by drawing on the tendon caused it to compress the sac slightly, and so

force air through the smaller tracheal vessels. Mr. Lowne published his belief that the muscular movements of insects were a main cause of the respiratory circulation in his work on the fly, and looked upon these sacs as a strong confirmation of his view.

The proceedings terminated with a conversazione, at which the following objects were exhibited :—

Pulex irritans (alive)	by Mr. Furlonge.
Paste Eels (alive)	by Mr. J. F. Gibson.
Foot of Water Spider	by Mr. H. T. Gray.
Pulex irritans	by Mr. des Guimaraens.
Section of Greegree	by Mr. Jackson.
Sections of Fossil Wood	by Mr. J. R. Leifchild.
Spores of Penicillium	by Mr. Martinelli.
Cuticle of Equisetum hyemale ...	by Mr. J. W. Meacher.
Scale of Eel	
Sting of Wasp	
Flea (Polar)	
Ova of Planorbis corneus	by Mr. J. A. Smith.

R. T. Lewis.

THE SOIRÉE.

Friday Evening, March 17th, 1871.

By kind permission of the Council of University College, the Annual Soirée of the Club was again held in their commodious Library, Museum, and contiguous rooms. The company began to arrive shortly before eight, and continued to swell until nine, when others kept dropping in, till lovers of early hours began to retire. The Soirée this year was in no respect behind any of its predecessors, except perhaps in one feature, which was universally regarded as an advantage, that there was less crowding, accounted for by the number of tickets being limited in issue to members, upon the principle of last year. The interest manifested by the members, and the satisfaction exhibited by visitors of both sexes, gave no sign of decadence. There was the same sturdy phalanx of members who had their microscope, and something under it, and the same smiling and blooming troop of female friends peeping anxiously down the hundreds of brazen tubes erected for their delectation. The prophecy that these "shows" would soon come to an end, which some crusty antiquarians have been known to utter, seems as far distant as ever. Here at least was no evidence that the era of Soirées is coming to a close. The Quekett Club seems resolved not to be first to discontinue or slacken in their efforts to hold a "gala" once a year.

The following are some of the objects exhibited by members and friends in the Library and Museum. Unfortunately this list is very imperfect, and by no means represents all the objects exhibited. It is hoped that on future occasions exhibitors will assist the Soirée Committee to obtain a more complete list. This will not only be an advantage to the Club, an acquisition to the Journal, but also a record for the convenience of members themselves.

Ackland, W.,	Hairs of Buckthorn leaf, polarised by his neutral tint selenite stage.
Adkins, W.,	Scales of Sole.
,,	Eggs of Water Insect.
Allbon, W.,	*Anguinaria spathulata.*
Andrew A. R.,	Eggs of House Fly (*Anthomyia*).
Andrew, F.,	Jaws of Cricket.
,,	Parasite of Ox.
,,	Acari of Sparrow.
Bentley, C. S.,	Embryo Oysters (opaque).
Bevington, W. A.,	Hippuric Acid (polarized).
Blankney, F.,	Balloon Newspaper from Paris.
,,	Scales of Ferns shown with new revolving mica selenite stage.
,,	New live box for spot lens.
,,	New Tank Microscope.
,,	New Portable Microscope.
Brown, W. J.,	Polycystina (Barbados).
Burgess, M.,	Hairs on leaf of *Onosma Tauricum.*
Burr, T. W.,	Living Flowers.
,,	Photographs of the Moon.
,,	Minute Writing, "The Lord's Prayer."
Cocks, W. G.,	Volvox globator.
Cottam, A.,	Transverse section of Porcupine Quill. (Polarized light.)
Fitch, F.,	Ciliary action in Mussel.
,,	Spider's web and victims.
Fricker, C. J.,	Crystallized Silver.
Fryer, G. H.,	Eggs of Red Spider.
,,	Tank Life.
Furlonge, W. H.,	Dissection of the pygidium of Bed Flea *(Pulex irritans)*, shewing the trachea and rectal papillæ.
,,	Dr. Barker's new Paraboloid, for dark ground illumination.
Gardiner, G.,	Circulation in Frog.
,,	Table Kaleidoscope.
,,	Diagrams of Lenses.
Gay, F. W.,	A drop of Vinegar with Anguillidæ.
Gibson, J. F.,	Spinnaret of Spider.
Golding, W. H.,	Circulation in Frog's Foot.
,,	Elytron and Legs of Brazilian Diamond Beetle.
Greenish, T.,	Section of Tooth showing Enamel and Dentine.
Guimaraens, A. de S.,	Section of New Red Sandstone from Carlisle. (Polariscope.)
Hawksley, —	Eye of a Spanish Dog, showing optic disc, nerves, arteries, &c., in the retina; shown by self-illuminating ophthalmoscope.
Hainworth, W. Jun.,	Entomostraca.
Hind, F. H. P.,	Diatoms.
Hopkinson, J.,	*Daphnia pulex*, or Water Flea.
Hovenden, G. W.,	Crystals from the Cork and bottom of a Bottle of Claret.
Jones, E. F.	Marine Alga (*Ceramium ciliatum*).

JACKSON, B. D.,	Section of Pear, showing gritty tissue.
JAQUES, E.,	Wing of Apollo Butterfly.
KILSBY, T. W.,	Section of Horn of Rhinoceros.
LEE, HENRY, F.L.S.,	First stage of the Prawn.
,,	First stage of Lobster (*Homarus vulgaris*).
LOWNE, B. T.,	Ocelli on the Wings of Butterflies.
MCINTIRE, S. J.,	Palate of *Sepia officinalis*.
,,	Palate of *Phasianella australis* (polarised light).
,,	Leg of *Hypomeces squamosus* (Chinese Diamond Beetle).
MARTINELLI, A.,	Branchial processes from the gill of an Eel.
MATTHEWS, Dr.,	Carapace of Prawn (polarised light).
,,	Capsules of Mosses.
MEACHER, J. W.,	Flea (*Pulex irritans*).
,,	Cuticle of Equisetum.
,,	Salicine.
,,	Section of Agate.
OXLEY, F.,	Pencil tails (*Polyxenus lagurus*).
,,	Pollen of Mallow.
PERRY, F. T.,	Comb from Foot of Spider.
QUICK, G. E.	Head of Gnat (*Culex pipiens*).
,,	Gizzard of Cockroach.
RAMSBOTHAM, Dr.,	Hairs of Leaf of *Alyssum alpestre*.
,,	Hairs of Leaf of *Onosma Tauricum*.
REEVES, W. W.,	Section of Skin from the Sole of a Baby's Foot, showing sudoriparous glands.
,,	Section of the Tongue of a Cat (injected).
,,	Section of the Human Finger (injected).
RIDDLE, E.,	Marble from the Seats of the Judges in the Ruins of the Temple of Claudius Cæsar, at Ephesus.
,,	Tongue or Proboscis of Moth.
,,	Granite from Djebel Moussa, or Mountain of Moses, Sinai; brought to this country by Capt. Wilson, who made a survey of the whole mountain.
ROGERS, J. R.,	*Hydra vulgaris*.
ROGERS, T.,	*Lophopus crystallinus*.
RUSSELL, JAS.,	*Melicerta ringens*.
,,	Water Flea (*Daphnia pulex*).
,,	Cyclosis in Anacharis.
RUSSELL, JOS.,	Larva of Dytiscus, shewing Trachea.
,,	Foraminifera.
,,	Circulation in Gill of Tadpole.
RUSSELL, T. D.,	*Tubulipora patina*.
,,	A Collection of British Crustacea.
SMITH, A.,	Peristomes of Mosses.
,,	,, *Funaria hygrometrica*.
,,	,, *Bryum capillare*.
,,	,, *Tortula unguiculata*.
SMITH, JAS., F.L.S.,	Echinus with Spines *in situ*.
,,	Eye of Goliath Beetle.
SMITH, W. W.,	Echinus Spine (section).
SUFFOLK, W. T.,	Stellate Hairs of Petal of *Correa*.

TAFE, J. F.,	Scales of Weevil from Philippine Islands *(Curculio pachyrhynchus)*.
,,	*Trichina spiralis* in human muscle.
WRIGHT, E.,	Leg of Beetle from China.
WHITE, T. C.,	Toe of White Mouse (polarised)
,,	Tongue of Wasp.
YOUNG, J. T.,	Eye of Mouse, with Sclerotic removed.
,,	Cuticle of Mistletoe Leaf.

In all 91 microscopes were contributed by 71 members.

In addition to the above, eight members of the Croydon Microscopical Club exhibited as representatives of that Club.

Dr. Marshall Hall exhibited Sponges, &c., obtained in the Norna Expedition.

Fossils were shown by Mr. E. Swain.

Mr. T. D. Russell also exhibited some of his Natural History Collections.

The Chromatic Stereoscope was shown by Mr. W. J. Cocks.

A Graphoscope was exhibited by Mr. T. Crook.

Mr. W. E. Dawes, jun., of High Street, Denmark Hill, exhibited a choice collection of Stuffed Birds.

Mr. Apps, of West Strand, employed one of the dark rooms for the exhibition of Electrical Experiments with Induction Coils, Gesler Tubes, Gassiott's Cascade, &c.

In the Mathematical Theatre Mr. James Martin, of the London Stereoscopic Company, exhibited on a screen some Photographs of scenes illustrative of the late war, by the Oxy-hydrogen light

The Flaxman Drawings were exhibited in the Shield Room, by permission of the Council of University College.

An interesting collection of Photographs of Indian Architecture, kindly lent for the occasion by Dr. Forbes Watson, F.L.S., of the India Museum, were exhibited in the Museum, together with other Photographs by Mr. J. Van Voorst, Mr. John Foster, Mr. E. Kiddle, and Mr. A. Shapcott.

The following opticians also exhibited microscopes, objects, and other articles of interest :—Mr. C. Baker, 244, High Holborn; Messrs. Beck and Beck, 31, Cornhill; Mr. C. Collins 157, Great Portland-street; Mr. H. Crouch, 51, London Wall; Mr. T. Curties, 244, High Holborn; Messrs. Horne and Thornthwaite, Newgate-street; Mr. W. Moginie, 35, Queen-square; Messrs. Murray and Heath, 69, Jermyn-street; Messrs. Powell and Lealand, Euston-road; Mr. T. Ross, 53, Wigmore-street; Mr. J. H. Steward, 406, Strand; Messrs. J. and E. Swift, 43, University-street.

ERRATA.

The remarks of the President, printed in pp. 149, 153 to 156 of the last number, were unfortunately sent to press without careful revision. and it may, therefore, be well to explain that the observations in the last five lines of p. 149 refer to Mr. Darwin's hypothesis of Pangenesis. In the second line of p. 156 "pulmonary artery" has been substituted for "aorta."

On the Pulex Irritans; or Bed Flea.

By W. H. Furlonge.

(*Read 24th February*, 1871.)

The single family of the Pulicidæ, to which the common or bed flea belongs, is, I believe, generally classed with the Aptera, or Aphaniptera, though it is, by some naturalists, referred to the order of the Diptera. It is composed of very numerous species, which are found upon a vast number of animals, on which they are parasitic. Many of these species present peculiarities of form and structure of great interest, and are found to vary in the most remarkable manner with the species of the animal they infest. The field of observation yet to be explored, with reference to the Pulicidæ, is a very extensive one, and although the present paper relates entirely to the one species, I may just remark, as illustrative of the interest of the subject, and the varieties of structure found in the different species, that certain fleas,—notably those of the mole, mouse and bat,—are either entirely destitute of eyes, or possess them only in the most rudimentary form,—the antennæ, on the other hand, as if in compensation,—being very largely developed;—that the fleas found upon many kinds of birds are furnished with plumose antennæ of great beauty, which in many cases are carried erect;—and that the position, numbers, and form, of the spinous processes and hairs of the fleas of different animals, present such well-marked and constant variations, that, in many cases, it is quite possible to identify, with absolute certainty, the species of the animals upon which they have been found. With these general remarks upon the family of the Pulicidæ, I now turn to the special species which forms the subject of the present paper.

The general form and outline of the bed flea, or *Pulex irritans*, is remarkably symmetrical, and even graceful. Although encased in a suit of mail of the most complete description, such is the wonderful adaptability of the parts composing it, that the most active

movements of the animal are in no way impeded, and perfect flexure of the joints is permitted in every direction. This armour is composed of exceedingly tough, thin, plates of chitin, of a pale yellow colour, which assumes a deeper tint with age, and are exquisitely marked with irregular striations. These plates are very transparent,—in young specimens almost perfectly so,—highly polished and lustrous. The shape and relative size of the male and female flea are somewhat different, the former being always smaller and shorter than the latter.

The external structure of the flea, as of the insecta generally, is divisible into three parts—the head, the thorax, and the abdomen, with their respective appendages. It will be convenient to describe these parts in their order.

The Head.—The head of the flea is singularly small in proportion to the size of the animal. It is encased in a helmet of polished chitin, composed of two pieces—the anterior, or clypeus, and the posterior, or epicranium,—which are united by a nearly perpendicular suture, of a light brown colour. The exterior surface of the head piece is pitted with numerous minute depressions, from each of which a very small spicule projects backwards. The head is attached so closely to the thorax, that at first sight it almost appears to form its anterior segment; but it is, nevertheless, capable of considerable movement in every direction. Several small square flaps, or neck plates, are hinged to the posterior edge of the head piece, which slide freely over the first segment of the thorax.

The Eyes.—Undoubtedly, the most striking of the organs pertaining to the head of the flea are the eyes. When examined under a $\frac{1}{2}$ inch or 4-10ths objective, by reflected light thrown upon it by the side parabolic illuminator, the eye of the flea presents an object of singular beauty. It is found to consist of a highly refractive, single, crystalline, lens, of great brilliancy, the retina pigment of which is intensely black. Its form is probably spherical, or nearly so, but it is so set that only a small portion of the lens is visible. It is situated at the anterior, convex, margin of a deep cavity, having a nearly semi-circular outline, the curved and diametric edges of which incline downwards, to form a somewhat pyramidal and rather deep, excavation, in the side of the head. Nearly one half of this cavity is covered by a thin, fixed, semi-transparent plate, formed by the extension of the anterior portion of the headpiece, which,

starting from the upper anterior portion of the margin of the cavity, curves, downwards and backwards, to the lower edge of its base, a little behind the eye, which is entirely surrounded by this projecting plate.

The Antennæ.—Within the chamber thus formed, is situated a highly curious organ, of complex structure, apparently composed of a somewhat soft substance of a yellowish-white colour. Its form resembles that of a curved pear, the smaller extremity being turned upwards and backwards, and appears to form the orifice of a tube curving backwards, and expanding into the posterior bulbous extremity of the organ, the upper edge of which is apparently pectinate, owing to the bulb being transversely cleft, for about half its thickness, into laminæ. The entire organ is attached to the anterior portion of the cavity, by a short muscular foot-stalk or peduncle, by means of which it can be thrust out, almost at a right angle, horizontally, over the edge of the cavity, at the will of the animal. A remarkable row of very long, stiff setæ, of a whitish colour, and about 10 in number, spring from the curved anterior portion of the organ, projecting backwards and lying in a nearly horizontal position above it, for the whole length of the cavity. The fringe, or brush, thus formed, may, perhaps, simply serve to protect the delicate structure beneath from particles of extraneous matter, but it is, in my opinion, more probable that they are *sensorial hairs, or setæ*, which convey impressions to the brain, or nervous ganglia, lying behind the base of the peduncle.

For the more complete protection of this obviously very delicate organ, a long triangular flap, or valve, of extremely thin membrane, is attached to the edge of the lower portion of the fixed chitinous plate previously described, and of which it, in fact, forms, a continuation, when the organ is at rest, so as to cover over about two-thirds of the opening of the chamber, but when the organ is protruded the valvular flap is pushed down, returning to its erect position when the organ is retracted.

The curious pair of organs just described, have generally, and no doubt properly, been regarded as the antennæ of the insect, but, after much observation, I cannot resist expressing the conjecture that they may probably—specifically, if not solely—serve the purpose of *hearing organs*, my reason for this suggestion being as follows:—From their position, the organs in question are capable of only very limited movement, and from their peculiar structure,

they appear wholly unsuitable to the tentative, olfactory, and probably other sensorial purposes, served by the antennæ as ordinarily placed in insects, and when to these considerations is added the reflection that there is something so very suggestive of *acoustical* purpose in the thin membranous plates, extending over deep chambers in the head, as also in the laminated and apparently tubular structure of the organ itself, and in the arrangement of the long stiff setæ stretching over it, so manifestly adapted to the conveyance of the vibratory impressions produced by sound, it is difficult to resist the inference, that the organ, as a whole, is, at all events mainly, one of hearing. It is, however, proper to remark, that in hazarding this opinion, I submit it upon hypothetical grounds only, as at present I have no proof to offer, of the existence of any bodies homologous with the *otilithes* of the higher animals, such, for example, as those bodies observed by our friend, Mr. Lowne, in the halteres of the blow fly, which organs he has thereby been enabled, with great probability of correctness, to identify as the hearing organs of that insect. Until some such bodies, therefore, have been made out to exist in the antennæ of the flea, the conjecture I have ventured to make as to their being hearing organs must, despite all my reasons for the opinion, be confessedly submitted as purely provisional and, indeed, hypothetical.

The Mouth and its Trophi.—We now come to the consideration of the mouth and the complex set of organs composing it. These, it is by no means an easy matter to make out, in all their details, in a perfectly satisfactory manner, and though I have devoted much time to the investigation, I am doubtful whether I have been able to apprehend, if even to see, all that really exists. The following, however, is the best description I am at present in a position to offer of this beautiful apparatus.

The mouth of the flea appears to be composed of nine distinct parts or organs, viz.—

Two maxillæ, two maxillary palpi, two labial palpi, two mandibles, and the ligula, or suctorial organ.

The Maxillæ are attached to the lower frontal portion of the head on either side, just within the margin of the headpiece, and consist of two nearly triangular leaf-like plates of chitin, somewhat thick at their junction with the head, but gradually diminishing in substance until they terminate in very thin, pointed extremities, which project downwards. The maxillæ are not moveable, and ap-

pear to serve the purpose, chiefly, of external sheaths or protective pieces, to the more delicate organs situated between them.

The Maxillary Palpi are a pair of four-jointed, tubular organs, springing from the anterior portion of the head, and, in their normal position, project perpendicularly downwards in front of the other trophi of the mouth. Three of the four joints are cylindrical, slender tubes, or lobes, having a nearly similar length and diameter, the terminal lobes being somewhat flattened and spoon-shaped. The lobes composing the maxillary palpi, are all characteristically marked by several transverse bands of chitin, which nearly surround, and doubtless serve to strengthen, the thin, chitinous walls which envelope them. Their exterior surfaces are thinly studded with short, fine setæ, which probably serve to convey sensorial impressions to the transparent and, I think, fluid contents of the lobes. In the living animal these organs are in continual, active movement, being pointed upwards or laterally, independently of each other, and are frequently applied to the surfaces of external objects, as if for the purpose of ascertaining their nature and properties, in a manner apparently much more analagous to the action of the antennæ of such insects as the ants and cockroaches (which seem to be employed as tactile organs) than to the functions of the maxillary palpi of insects in general. I am inclined from these observations, to submit the conjecture, in connection with my hypothesis as to the special sense of hearing which I suppose to be served by the true antennæ, whether the maxillary palpi may not, in the flea, act as supplementary or *pseudo* antennæ, by conveying impressions of surrounding objects, which, from the latent position of the real antennæ, these organs are unfitted to acquire?

The Labial Palpi are organs of very curious construction. They are each composed of four tubular joints, (see Fig. 6) united or fused at their extremities, so as to form one tubular tenon, in which is inserted a narrow, straight, blade of very transparent chitin. The top or back of the blade is rather thick, but gradually thins, like a wedge, to an exceedingly keen cutting edge. The extremity of the blade is pointed and projects for some little distance beyond the tenon in which it is set. The tenon itself, is strengthened by a layer of thickened brown chitin, and from each of its divisions two setæ project forwards, and four somewhat longer hairs spring from the extremity.

The Mandibles consist of two very long, thin, narrow and straight

blades of chitin, the outer surfaces of each being convex, so that, when closed together, they form a tubular channel or sheath, within which the suctorial organ, or ligula, is situated. Around both edges of each curved blade, is set a row of glittering, very transparent, round and pointed teeth, curving backwards or upwards. These teeth are not formed by the serration of the edges of the blade, but appear to be composed of a different and somewhat glassy material, and are inserted, *separately*, in the substance of the mandibles—after the same manner in which the teeth are set in the rostrum of the saw fish, to the structure of which, Gosse aptly compares that of the mandibles of the flea. Immediately behind the marginal fringe of teeth, and running parallel with it, along the outer or convex sides of the blades, is placed a second row of glassy teeth, which seem to me to possess a totally different structure from those of the margin, being shorter and stouter, somewhat pyramidal in shape, and standing perpendicularly upon square bases; and they, moreover, do not appear to be inserted in sockets as in the case of the marginal teeth. Each row contains about 75 teeth, so that the four double rows upon the pair of mandibles are furnished with no fewer than about 600 separate teeth!

The Ligula or *Suctorial Organ*, as just stated, lies between the concave surfaces of the mandibles, which, when brought together, surround and protect it. It consists of an elongated, slender, flexible, proboscis, having, as I believe, an annular muscular structure, at least, the tubular channel running through it is certainly striated. The ligula originates at its junction with the alimentary canal, in an elongated fusiform cavity, and terminates in a somewhat bulbous enlargement, the orifice of which is distinctly fimbriated, though this structure can only be made out by the employment of an objective of very high power, say a one-sixteenth. Along one side of the organ is set a series of 11 or 12 rounded, or sub-angular, projections (see Fig. 5) which are placed at regular and rather wide intervals, for about one-half of the lower portion of the ligula. It is extremely difficult to determine, with accuracy, the true nature of these prominences, but I think I am in a position to state, with tolerable certainty, that they consist of thin rounded plates or teeth of chitin, set edgewise in the substance of the organ, and connected by exquisitely thin cutting edges, curving down between the prominences—the whole arrangement very much resembling the saw of some species of saw flies. The use of this curious organ is doubt-

less to enlarge the orifice, probably first formed by the mandibles and maxillary palpi, and thus to promote the flow of blood. A high power and very careful illumination, is required to resolve the structure of this organ, to which I would desire to direct the attention of some of the accomplished observers numbered amongst the members of this club, the more especially as the result of my own observations leads me to differ materially from the conclusions of Mr. Gosse. In a popular description of the trophi of the flea,* this distinguished naturalist states that the labrum or upper lip, as he terms the organ, consists of a narrow chitinous blade, having *both its edges* studded with teeth similar to those of the mandibles, but set in a single row. It seems to me, however, that the organ is not a chitinous blade, but a fleshy, and, I think, muscular, proboscis, perforated throughout by a canal, and that certainly, it is not surrounded by a row of teeth.

We now proceed to the description of—

The Thorax, which, as in insecta generally, is formed in three segments, the pro-thorax, the mezo-thorax, and the meta-thorax, each division carrying one pair of legs.

The pro-thorax, or anterior segment, consists of three thick plates of chitin. The superior plate embraces and defends the back, resting upon it like a saddle, of which the truncated flaps descend on each side, to the angle of the head piece, at which point they meet, and are united to, the two lateral plates, nearly pyramidal in shape and convex outwardly, which enclose, and in fact constitute, those parts of the pro-thorax to the anterior angles of which the first pair of legs is articulated. The three plates composing the pro-thorax (as is also the case with the plates of the other segments,) are attached to, and in reality form parts of, a thick membranous skin, enveloping the whole animal, and which, it may be remarked, seems to serve a purpose analogous to that of the coat of thick buff leather worn by the knights and men-at-arms of old beneath their armour. But only the anterior half of the upper or back plate, is thus attached to the membranous skin, the unattached posterior half overlapping the second segment of the thorax, and moving freely upon it. From the line of junction of the upper plate with the skin, a series of about a dozen stiff bristles or setæ, emerge at regular intervals and project backwards. These setæ pass through the chitinous substance of the plate in a horizontal direction, through

* Evenings at the Microscope—p. 178.

apertures slightly depressed, and furnished with projecting covers; but whether the setæ are rooted in the epidermis beneath, as I suspect, or spring from the plate itself, I have been unable to determine.

The mezo-thorax, or second segment, is likewise composed of three plates, the superior embracing the back, and descending on either side to about the medial line of the animal, where it terminates in crescent shaped extremities, into which are fitted the two convex lateral plates, which envelope and constitute the pyramidal extremities of the mezo-thorax, to which the second pair of legs is articulated at the posterior angles of their square terminations. I am not quite sure that a fourth plate, uniting the lateral plates beneath, does not exist. I have sometimes thought I could perceive, that the chitinous segment formed a complete ring or collar round the animal, but of this I am not certain at present. The anterior half of the upper plate of the mezo-thorax, is attached to the underlying skin, in a manner precisely similar to that already described, and from the line of attachment proceeds a like row of setæ. It may be noticed, that the chitinous plates composing this segment of the thorax, are considerably stronger than those of the pro-thorax, the additional strength being given by a marginal band of brown chitin, of equal width, surrounding each of the three plates like a frame. I may, in this place, advert to two extremely curious organs, so far as I am aware, not heretofore described, which are situated at the posterior portion of the soft part of the epimeron. These organs are round, dome, or nipple shaped prominences, which are capable of protrusion and retraction, and, in point of fact, are, in the living animal, continually in movement, sometimes being projected until the extremities assume an almost pointed conical form, and at other times retracted until the extremities of the cone become truncated and nearly flat. In the centre of each prominence is a cup-like perforation, which, it may be seen, is connected with a large tracheal tube beneath, of which it appears to form the external orifice. These curious organs are, without doubt, spiracles, apparently of a very peculiar type, and regarding them I shall have more to say in a subsequent part of this paper.

The meta-thorax, or third segment, is much the largest and strongest of the three, having to carry the third or principal pair of legs, by means of which, the animal exerts the wonderful muscular power, required for the accomplishment of its extraordinary

leaps. The strengthening of the plates, by the marginal deposit of additional material spoken of above, receives, in this segment, a still further development, and, for the purpose of giving yet greater solidity to the parts, stout transverse ribs or braces of chitin, at intervals, unite the anterior and posterior margins of the plates. In the meta-thorax, indeed, though, in fact, formed of three plates, like the two anterior segments, these are so firmly united or fused together, as practically to constitute one very strong plate, embracing the back and descending on each side, somewhat below the medial line, terminating in rounded sockets, the margins being surrounded, or nearly so, by strong rings of dark brown chitin, to the external edges of which, at the point of junction with the vertical band of chitin, the legs are attached. As in the first and second segments, the superior plate of the meta-thorax is united to the underlying skin by the anterior half only, and it would appear, as if the posterior vertical band of chitin is imbedded in the skin and forms the line of attachment of the plate to it, the posterior half overlapping and playing freely over the first segment of the abdomen. Three rows of setæ emerge from the meta-thorax, the anterior set from the middle line of the plate, the posterior row from its edge, and the third row is placed exactly between them. Each row contains about twelve hairs.

We now arrive at the description of—

The Legs, six in number, and carried, as before stated, in pairs, on each segment of the thorax, and attached to them in the manner already described. The anterior pair of legs is the smallest, the posterior pair considerably the largest and longest, but they are all composed of the same number of joints, which are arranged in a precisely similar manner. They consist of—

1. *The Coxa*, which in the flea is unusually large, and in fact constitutes the most important and powerful joint of the leg.

2. *The Femur.*

2. *The Tibia.*

4. *The Tarsi*, consisting of five joints, of which the upper is much the largest, the terminal joint carrying a pair of long, curved claws, which are capable of contraction, and spring from a soft pad studded with short hairs. The external surfaces of the legs are abundantly furnished with stiff setæ, of which the thickest and longest spring from the posterior margin of the tibiæ.

The flattened tubular joints composing the legs, are closely

packed, internally, with a dense mass of large, striated, muscular fibres, constituting the bi-penniform muscles attached to the tendons, which move the successive divisions of the limbs. These tendons extend to the extremities of each leg, and are attached to the long curved claws before mentioned, which are powerfully contracted by them. Along the line of the tendon runs a well defined tracheal tube, from which minute fibres branch in every direction and permeate the muscular substance.

I have here to describe a most remarkable pair of contractile sacs, which are to be found in the tibia and upper tarsal joint of the third pair of legs, and, I believe, also exist in the corresponding joints of the two anterior pairs in a less marked form; my reason for this opinion being that, in the cat flea, I have distinctly seen these sacs developed to an almost equal degree in all three pairs of legs, though they are not to be made out with certainty, in the two first pairs of legs of the pulex irritans.

The larger and more important of these curious organs is situated in the upper tarsal joint, through which it extends for the greater part of its length. It consists of an elongated, ovate, striated sac, through the axis of which runs the main tracheal tube supplying the limb. I have not hitherto been able to make out that there is any direct connection between the sac and the tracheal tube. The smaller organ is situated in the tibia, and consists of a long, flattened, membranous bag or sac, also surrounding the main tracheal tube, but it is not striated, nor, in my opinion, contractile.

Having watched the movements of these organs, in the living animal, by the hour together, I have no hesitation in describing them, strange as they must appear. The action of the contractile sac of the upper tarsal joint, is first, by slow distention, to become filled with air, the membranous sac of the tibia simultaneously collapsing. When fully distended, the tarsal sac suddenly contracts to about one fourth its previous diameter, when, at the same moment, the membranous sac of the tibia becomes fully inflated. This rythmical, alternate, movement sometimes proceeds, regularly, at the rate of two or three pulsations in the minute, but this is not always the case, as I have frequently found that it is suspended for longer or shorter periods, and in many specimens it is altogether wanting.

Believing that these remarkable organs have not hitherto been

observed, I have devoted much attention to them, and I think I am justified in expressing the opinion, that they probably serve a very important and hitherto unsuspected purpose, in the respiratory system of the animal, and further, if I am right in my conjecture, that similar organs will probably be found to exist in many other insects.

I think it possible, then, that these contractile sacs serve the purpose of pumps or syringes, by means of which air is drawn through the external orifices or spiracles, and propelled through the minute capillary vessels of the tracheal system. I am well aware that the suggestion sounds somewhat fanciful, but, if this be not their use, I am unable to conjecture what other purpose they can serve, and certain considerations, connected with the air circulation of insects in general, and of the flea in particular, to which I shall advert in another place, seem to point to the necessity for the existence of some such contrivance. I may add that, hitherto, I have not been able to discover any external orifice in direct communication with the contractile sac, though I fancy that such an orifice may exist. I would, however, invite the co-operation of my fellow members of the Club, in further observations upon these singular organs.*

We now pass to the consideration of the third division of the body of the animal, viz.:—

The Abdomen.—The abdomen is divided, vertically, into eight

* In the course of some remarks made by Mr. Lowne, after the reading of this paper at the Club, a full *resumé* of which will be found in the last number of the Journal, he referred to certain experiments he had made, with the object of ascertaining the true nature of these so-called contractile sacs, to which I had drawn his attention, as really existent, a few days before the reading of my paper. The result of these experiments and observations, it appears, led him to a somewhat different conclusion as to the structure of these organs, if, according to his views, they can be so termed. Mr. Lowne regards these sacs as being simply expansions of the main tracheæ supplying the limb, and the apparent muscular structure to which I attribute the rythmical contraction of the sac, he regards as a peculiarly marked development of the ordinary spiral fibre; and he looks upon the dilation and contraction of the sacs as being due to the disturbance of respiration by the action of chloroform, or even by pressure. Mr. Lowne's experiments and suggestions are certainly well deserving of attention, but as yet I have not had an opportunity of testing them. Meanwhile it is worthy of note that although Mr. Lowne entirely repudiates the idea that the contractions of the sacs is *the cause*, but is rather *the effect* of the respiratory process, he yet so far adopts my theory as to suppose that the muscular movements of the limbs compress these tracheal sacs, and that thus air is forced through the minute capillary trachea. For my own part, though I have directed the attention of the Club to the existence of these sacs, I do not feel competent to offer any opinion at present as to their real structure. In fact, I imagine that much careful *work* will be required before the true nature and office of these singular organs can be decidedly affirmed.

W. H. F.

zones, of which all but the two last are nearly equal in width, each composed of two, very thin, curved, semi-transparent plates of chitin, exquisitely striated, polished, and lustrous. The superior plates embrace the back of the abdomen, and descend, on each side, considerably below the medial line of the body. The inferior plates embrace the abdomen proper, and ascend to an equal distance above the medial line, the rounded extremities of the plates thus overlapping each other considerably—the superior plates being the exterior. The seventh pair of plates have a different form from the others, and are somewhat triangular in shape, the apices projecting backwards, and receiving between them the terminal segment of the abdomen. This segment is likewise composed of two plates, which differ in structure in the male and female animals, as will, afterwards, be more particularly described, when we come to the consideration of the organs of reproduction. It will be sufficient to say, here, that the upper terminal plate, in both sexes, is curved and somewhat triangular in shape, the apex, of course, projecting backwards, and is nearly divided into two equal parts by a large, rounded or oval opening or excavation, which bifurcates backwards to the extremities. In this opening is set the pygidium, as will presently more particularly be described. The lower terminal plate, which, in this segment of the abdomen, is the exterior, is also somewhat triangular in general form, the lateral terminations projecting a little beyond the extremity of the abdomen.

Owing to the transparency of the structures, it is very difficult to make out, exactly, how the abdominal plates are attached to the underlying epidermis, but it would appear as if the anterior portion only of each plate is thus attached—the posterior portion overlapping and playing freely upon the plate lying immediately behind it. But, however attached to the skin, each plate of the series is capable of independent movement in a radial direction, (considering the medial line as containing the central points of attachment of the plates), while each pair—superior and inferior together—frequently move in concert, in a horizontal direction, backwards or forwards, the segments of the abdomen thus, as it were, *telescoping* into each other.

The Spiracles.—Considering them as appurtenances of the abdomen, it will be convenient, here, to describe the external respiratory organs, or spiracles. Each of the superior abdominal plates

contains two spiracles, one on each side,—the whole series constituting two rows of these organs, ranged horizontally, about half way between the medial line and the top of the abdomen, on either side of the animal. The first or anterior pair of abdominal spiracles, however, is situated considerably above the general line, and much closer to the top of the abdomen. The superior terminal plate contains two very curious spiracles, presently to be described. Inclusive of the pair of spiracles, previously mentioned as situated in the mezo-thorax, therefore, the external respiratory organs of the flea consist of 18 spiracles, of which those contained in the seven anterior plates of the abdomen are almost identical in size and structure. They consist of nearly circular orifices in the chitinous plates, from the inner margins of which about eight or ten short, stiff hairs radiate, horizontally, towards the centre, thus forming a protective fringe over the openings. The orifices open into funnel-shaped cavities beneath, terminating in short tubes, which are connected to the main trachea in a peculiar manner, subsequently to be described. A remarkable development of the external respiratory organs, is found in the two spiracles just mentioned, as situated in the eighth or terminal superior plate of the abdomen. Around the margin of the excavation in this plate, (within which the pygidium is set,) and curving downwards on each side, is situated a long narrow groove or channel, (apparently formed by a duplication of the edge of the plate itself), which is thickly set with a fringe of short, stiff hairs. Near the superior termination of the channel, on either side, it is enlarged and deepened, so as to form a pair of trumpet-shaped funnels, the larger orifices of which are directed backwards—the smaller orifices being extended into short tubes, similar to those of the lateral spiracles, which are united to the main trachea, of which, in fact, they appear to constitute the terminal external orifices.

The Pygidium.—I now come to the description of the pygidium. (See Fig. 1.) This curious organ consists of a thick, soft, fleshy mass, of a light-brown colour, in shape something like a saddle,—the thickened rounded flaps of which descend on either side, the upper portion forming a sub-angular ridge parallel with the line of the abdomen. As already stated, it is set within the oval excavation in the superior terminal plate. The organ rises from, or is attached to, the surface of the epidermis, or the external fleshy portion of the animal's body, and is capable of free movement, sometimes being

protruded considerably, and sometimes being retracted beneath the margin of the excavation in the terminal plate. The soft spongy mass, of which the organ appears to be composed, is perforated by a variable number of circular orifices, from 24 to 28 in number, between which the surface is thickly studded with very short, brown, spinous hairs. These orifices open into hemispherical cavities, around the margin of each being inserted a flat, chitinous ring (see Fig. 2), from which about ten or twelve flattened bands or spokes, of the same width, radiate towards the centre for about half the radius, altogether constituting a flat disc, the inner margin of which appears dentated, (except under very high powers), from the projection of the flat bands or spokes, From the bottom of each cup-shaped cavity, arises a fleshy cone, the apex of which is in the centre of the discoid ring, and from it emerges a long, fine, straight, single hair of great flexibility.* These hairs collectively constitute a tuft or brush of singular beauty, the hairs standing nearly upright, or inclining slightly outwards.

When a young and transparent specimen,—of which the large intestinal sac is well filled with blood,—is gently compressed and examined by light reflected from a side parabolic illuminator, numerous thread-like tracheal tubes, (see Fig. 4) may be seen most distinctly, proceeding from the under surface of the pygidium, (presumably from the orifices therein), and uniting together into several larger tubes which join the upper main tracheæ of the insect. It is very interesting to watch the constant movements of the pygidium, upwards, downwards, and laterally, and the consequent waving motion of the white thread-like vessels proceeding from it, projected upon the dark back ground of the intestinal sac behind, which owing to the transparency of the chitinous envelope, can be seen most clearly.

There has been, and still exists, considerable diversity of opinion as to the use or purpose of this very curious organ. By some it has been supposed to be connected with the respiratory system, by others it is suspected that it fulfils some undiscovered office in the reproductive functions of the insect,—while the more cautious observers contend that, as yet, we possess no knowledge whatever on the subject. I certainly am not in a position to solve the problem, though I frankly confess that—having reference to the very

* The ideal section of one of the orifices shewn in fig. 3 explains my idea of the structure I have described.

numerous tracheal vessels which, as just described, proceed from the under surface of the organ and are united to the main tracheæ of the animal—I did strongly hold the opinion that the office of the pygidium was *respiratory*,—in fact, that it was a collection of spiracular orifices. Certain facts, however, which have very recently been brought under my notice by our distinguished member Mr. Lowne (who, I believe, inclines to the view that the pygidium is in some way connected with the reproductive organs), seem to militate greatly against the respiratory theory, which I, therefore, feel compelled provisionally to abandon. The recent discovery of a similar organ in the lace fly, however, will probably attract increased attention to the subject, and we may hope that, at no distant date, the true interpretation of this extraordinary structure will be discovered.

Having now completed my description of the external structure of the flea, with the exception perhaps of the male organs of generation, which will be more conveniently described in another place, I come to the consideration of the structure of the internal organs of the animal, which present features of great interest.

I had hoped to have been able to complete my whole subject on the present occasion, but I think it will be better to reserve the second division of my paper for another communication, which I hope at an early opportunity to have the honour of bringing before the Club the more especially as I desire on that occasion to append some contributions to the life-history, and development of the insect, which, I trust, will not be wholly devoid of interest.

PLATE XV.—Bed Flea (male) × 250.

PLATE XVI.—Fig. 1, superior terminal plate, showing pygidium and pair of spiracles; 2, side view of pygidium, showing the tracheal tubes; 3, enlarged figure of a single orifice in the pygidium; 4, ideal section of the same; 5, the labium or ligula; 6, the labial palpi.

On a Specimen of *Diplograpsus pristis* with Reproductive Capsules.

By John Hopkinson, F.G.S., F.R.M.S.

(Read March 24th, 1871.*)*

In looking over a few Graptolites which had recently been received by Mr. Etheridge at the Geological Museum, I detected a specimen which appeared to be a *Diplograpsus* bearing reproductive capsules. About half the graptolite as it is now seen was visible; and this portion showed the reproductive organs, but no hydrothecæ, the proximal end being imbedded in the shale. On clearing away the shale, the specimen, which Mr. Etheridge kindly lent me for examination, proved to be a tolerably well-preserved impression of *Diplograpsus pristis*.

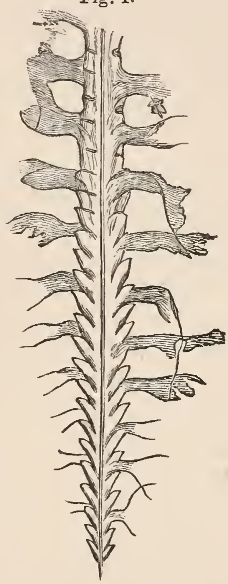
The graptolite appears as a silvery pyritous impression on the surface of the shale. The proximal termination is indistinct. A slender radicular process, continuous with the solid axis, can just be made out. At the distal end the shale is broken right across the polypary, which here shows no signs of coming to a termination. One inch only is exposed.

The solid axis is clearly seen throughout. The hydrothecæ, towards the proximal end, are very distinct; the apertures of those on the left-hand side are clearly seen, extending partly over the periderm, while those on the right-hand side are partially hid. There are twenty-four in the space of an inch. Towards the distal end the apertures only of a few of the hydrothecæ are seen; they appear as "scalariform impressions" on the surface of the polypary.

The reproductive organs, which I consider to represent the gonothecæ of the recent Sertularian zoophyte, are developed almost immediately opposite each other from each side of the periderm and throughout its whole length. Though at equal intervals from each other, they are in no even numerical relation to the hydrothecæ,

there being ten to the inch. They appear to have budded from the periderm at right angles to the hydrothecæ, and thus have caused the polypary to be unevenly compressed. The most perfect are pear-shaped in form, 1-6th of an inch long, and at their narrow end, by which they are attached, about 1-30th of an inch wide. They have apparently been bounded by a single marginal fibre, which is slightly thickened at its edges, and, where the pyrites is removed, has impressed a fine double groove on the surface of the shale. If the fibres were slender tubes this appearance would naturally be presented; for their outer margins would offer the greatest resistance to compression. The so-called solid axis of the graptolite frequently presents a similar appearance. At the proximal end of the polypary these fibres only are preserved, the oldest, or first-formed gonothecæ having fulfilled their function and perished. The distal extremity of even the most perfect is not clearly defined, the impression of the capsule in most cases becoming gradually less perceptible from the proximal to the distal end. Sometimes the capsules are irregularly ruptured, their torn jagged edges being distinctly seen, while one has split along its marginal limit, along the line of the marginal fibre, which appears to have parted abruptly near the distal end of the capsule at one side, and split acutely for some distance along the other side. This would appear to indicate that the capsule may be composed of two membranes joined together at their edges, through which the fibre, if it be not merely a tube formed by a kind of double marginal seam, has run. In no case can a distinct unruptured distal orifice be traced.

Fig. 1.



Diplograpsus pristis with reproductive capsules. Magn. 3 diameters.

The gonothecæ present other peculiar appearances. Towards their proximal end they are sometimes longitudinally corrugated

or crumpled, or traversed by fibres which extend for some distance, into the body of the polypary. Some are much twisted and bent about, occasionally overlapping each other. Between two which thus overlap, or perhaps only come into contact with each other, just at the point of contact and apparently within one of the capsules, are two minute young graptolites, one lying across the other. Each consists of a thin membrane, probably forming the first partially developed pair of hydrothecæ, a minute radicle, and a slender solid axis, which is prolonged beyond the membrane. They are similar in form and proportions; but one is a little larger than the other. Its length, from the extreme point of the radicle to the distal end of the axis, is 1-20th of an inch. The membrane itself is about half this length, and 1-60th of an inch wide, tapering towards the proximal end. The smaller specimen is 1-30th of an inch in entire length and 1-80th wide. If these young forms had not been in connexion with a mature graptolite they would have been considered to belong to the genus *Diplograpsus*, but it would have been impossible to refer them to any species. In their present position I think we may without hesitation infer that they are the young of the graptolite with which they are associated. That they have not yet entered upon independent existence we cannot conclude; for they are in different stages of growth, and young graptolites are frequently met with in a less advanced state than either; indeed on the same piece of shale there are several young graptolites referable to the same species, and no more developed, some even less so.

Fig. 2.

Young graptolites.
Magn. 6 diams.

This is the only graptolite with undoubted reproductive organs yet known to have been found in Britain. In America, however, Professor James Hall has detected diprionidian graptolites with what he describes as "reproductive sacs" or "ovarian vescicles." These are figured and described in his "Graptolites of the Quebec Group." In Britain Dr. Nicholson has described and figured, in the "Geological Magazine," monoprionidian graptolites with what he has termed "grapto-gonophores." If these should prove to be, as Dr. Nicholson believes, the reproductive *buds* of graptolites, the monoprionidian graptolite is reproduced in a totally different manner to the diprionidian; but I think we have as yet had no sufficient

evidence brought forward to prove that these problematical bodies have even any connexion with graptolites. The discovery of this specimen throws no light upon this mode of reproduction. It affords, on the other hand, a decided confirmation of Hall's observations; and as his views have not been generally accepted, the specimen is perhaps of more value than if it were unique. The reproductive sacs figured by Hall are essentially similar to the gonothecæ I have here described; upon the surface of the shale on which they occur there are numerous young graptolites in various stages of growth; and in one specimen figured, "in connexion with one of the sacs there are two minute germs, one of them lying beneath the sac, and the other just beyond its outer margin and barely separated from its fibres." *

The presence of these reproductive capsules throws some light upon the affinities of graptolites. It confirms the evidence which their internal structure has already furnished, of their near alliance with the Hydroida. The reproductive organs of the Actinozoa and of the Polyzoa being internal, graptolites cannot, as some think, belong to either of these classes. In the Hydrozoa they are external; and in some of the Hydroida (the only subclass of the Hydrozoa with which graptolites, having a chitinous polypary, can be compared) there are reproductive capsules essentially similar to those of the graptolite, although in no single instance entirely agreeing with them. We have no single recent Hydroid with reproductive organs enclosed in chitinous capsules which are destitute of any distinct orifice, are bounded by a marginal fibre, or composed of two membranes united at their edges, and at the same time bud from the periderm without interfering with the continuity of the hydrothecæ; but these appearances are all presented by one or other of the Hydroid zoophytes. In *Sertularia*, *Diphasia*, &c., the gonothecæ bud from the periderm in the same manner as in the graptolite; in several genera they are ribbed or thickened at their edges, and in one genus, if not in more, they have no definite distal orifice. In *Aglaophenia*, I have been kindly informed by the Rev. Thomas Hincks, the gonotheca "is oval in form, without orifice, and bounded by a very thin and delicate chitinous wall."

I need only add that graptolites, having, as is here shown, true gonothecæ as well as hydrothecæ, are most nearly and intimately

* Grapt. Quebec Group, expl. pl. B. fig. 8.

allied to that order of the Hydroid Cœlenterata known as the Thecaphora or Sertularina.

The specimen which has formed the subject of these remarks was collected by the Geological Survey of Scotland, at Leadhills, Lanarkshire, along with a series of fossils which parallel the rocks of this locality with those of Moffat, Dumfriesshire, or with the Llandeilo Flags of Wales.

On an Immersion Paraboloid.

By B. Daydon Jackson.

(*Communicated May 26th*, 1871.)

I have brought for exhibition an immersion paraboloid, thinking that a comparison of its powers and mode of working might be interesting to the members of the Club. In using the ordinary form of the paraboloid with the higher powers, for which it is intended—say, for instance, the four-tenths or quarter inch glasses—the moveable stop must be brought so near the object that the extremely oblique rays, coming from the very top of the illuminator, instead of passing through the slide by refraction, do not enter at all, but are reflected down on the stop which, in spite of its blackened surface, becomes capable of sending up so much light as to render the field of a neutral tint, or even of a light grey. Some of these defects are avoided by using the instrument to which I have called your attention. It is formed of a solid paraboloid of glass, ground to a different curve than the dry form, and instead of having its emergent surface hemispherically hollowed out, it is left nearly flat, a very slight concavity only being given. This concavity is so slight as to be hardly perceptible, but is intended to permit the slide in contact with it, by means of the water film, to be moved to and fro without danger of scratching the glass top of the illuminator—no very difficult thing to do, in spite of the apparent hardness of the substance. The stop to prevent direct rays passing into the microscope is cemented to the lower surface of the paraboloid. The object (*Eupodiscus argus*) is shown by a quarter-inch binocular with a black field; the angle of the object glass

being about 110°, a result I have not been able to attain so satisfactorily by any means previously employed. There is no loss of light by reflection from the lower surface of the glass, since the rays pass almost in straight lines from the curved sides to the focus. The ordinary test diatom slide, when mounted dry on the cover, as usual, present a curious appearance, the field being dark with a small spot of orange-brown light, occupying about one-fifth of the diameter, the spherules, however, being shown distinctly. I have not been able as yet to use this illuminator with higher powers, the fog surrounding the object unpleasantly.

My acknowledgments for the instrument are due to Mr. Ackland, who calculated the curve, and made the paraboloid; and to Mr. Suffolk, who obligingly placed all the data in his hands at the disposal of the first-named gentleman.

NOTICES TO MEMBERS.

The Annual General Meeting of the Club will be held at University College, on July 28th, at Eight o'clock, for the Election of Officers, &c.

Members are requested to deliver to the Secretary *the titles of papers and communications which they intend presenting to the Club at the Ordinary Meetings during the succeeding six months.*

PROCEEDINGS.

March 24th, 1871.—*Chairman*, Dr. Lionel S. Beale, F.R.S., President.

A list of donations to the club was read, and a vote of thanks passed to the respective donors.

Mr. Hopkinson, F.G.S., read a paper on a specimen of *Diplograpsus pristis.*

A vote of thanks was given to Mr. Hopkinson for his paper.

It was announced that the club was honoured by the presence of Dr. Harkness, of California, as a visitor.

Mr. Curties announced donations of specimens of bird parasites, presented through him by the Rev. J. Bramhall; of some photographs of sections of insects from Dr. Halifax, of Brighton, and of a series of photographs of illusory appearances from Mr. Hennah, of Brighton, accompanied by an explanatory letter having especial reference to the views of Dr. Pigott, in relation to the beadings on the podura scale.

A vote of thanks was passed to Mr. Curties, and to the gentlemen who had made the donations above referred to.

Mr. McIntyre said that some 14 months since, when he had read before the Royal Microscopical Society a paper on the structure of the scales of Thysanuræ, Dr. Pigott's paper was read before his, and created some sensation. It did not coincide with his (Mr. McIntyre's) views, but he remained silent after hearing it, because there was evidence that Dr. Pigott had seen something on the scales that had escaped the notice of previous observers, although he considered his interpretation of that appearance to be quite erroneous. In using high powers great care should be exercised in regard to illusory appearances which were due to illumination and correction of objectives, and in drawing a final conclusion the work which had been performed required to be constantly checked. In regard to diatoms, he thought all more or less presented appearances of beaded hemispherical elevations; perhaps there may be real beads like the crystals seen on silica. But the term beads, as applied to the appearances observed on the podura scale, had never satisfied him. He had long been aware that when looking on those scales with certain kinds of illumination, beaded effects were obtained, but he had always held them to be illusory. In reference to the test scale, *Lepidocyrtus curvicollis*, the interpretation he had put on Dr. Pigott's paper was that he (Dr. Pigott) was the first to find out the minute, transverse striation of the scale, evidence of the existence of which has been given in the photographs of the scale, taken in America. The photographs by Mr. Hennah

were, he thought, striking examples of the illusive effects of illumination, for nothing could be more definite, apparently, than the beaded structures which he produces, and yet they are proved to be perfect illusions. He would say a word relative to the latest observations on the last podura scale, the ordinary black podura. The creature is a distinct species, although the outline of it was precisely the same as the other members of the genus. But whereas they presented colours varying from two to three or more, that to which he referred was of a plain leaden or steel colour. The little clump of hairs seen in profile on other specimens of the podura is never seen in this one. The creature is more active than others of the class, and though the subject had not been thoroughly worked out as yet, the probability was that it would turn out to be a distinct species and very rare.

Dr. Harkness, at the request of the President, described a mode of exhibiting the circulation of the blood, to which he had drawn the notice of the members that evening. He said at the request of one of the members of the Club he had brought a few frogs for the purpose of illustrating under the microscope the circulation of the blood in the lung. The members were aware that in the family of the Ranæ the lung is a sac with rudimentary cells just beneath the pleura The lung being protruded, as it could be readily done by making an incision under the foreleg and through the covering membrane, the pleura, the circulation may be maintained for hours if the lung be moistened. He knew of no example of exhibiting the circulation which was so interesting or so striking as this might be made to be. Under a high power would be seen at a glance (the membrane being very thin), the *arterial, venous* and *capillary* circulation. There was also another matter connected with this experiment to which he would call the attention of the Club. The lung being covered with a serous fluid, by dropping a pellicle of water upon the lung, it would sometimes be possible to produce the effect of a compound microscope. When moistening the lung with a toothpick or small glass rod, he had been able to obtain a small globule of water almost spherical, and by bringing the instrument to bear upon that specially he had obtained a magnifying power of 1,000 or 1,500, while using no higher power than the inch object glass, equal to a power of about 100.

The thanks of the meetiug were given to Dr. Harkness.

Mr. Lowne made a statement with reference to the white blood corpuscles of the newt which he was exhibiting, and said that some very extraordinary phenomena might be observed in leucocytes, or white blood corpuscles. He said that although those which he was exhibiting appeared to be dead, yet after resting for a short time they would probably manifest signs of vitality, and exhibit the phenomena he was about to describe. The blood had long been known to contain two kinds of corpuscles, white and red. The red are elliptical in shape in most ovipara, as birds, reptiles, and fish, but circular in mammals. The white corpuscle was discoid only when dead; when it was alive it put forth processes very like the pseudopodia of the *amœba*. These blood corpuscles are little masses of living tissue which circulate in the blood, and viewed under favourable circumstances, could be seen adhering to the walls of the vessels, and putting forth the pseudopodia-like processes alluded to. If the blood be taken from the vessels and observed under its natural conditions, those processes would still be seen to be put forth. If our own blood be taken it would be necessary to exercise care to keep the temperature very accurately up to the ordinary temperature of the body, as a little deviation from it would prevent the movement of the leucocytes, but if the blood be taken from cold-blooded

animals living leucocytes might be seen at the ordinary temperature of the atmosphere. In making these experiments, Dr. Burdon Sanderson recommended that putty cells should be employed; they were easily made, and by placing the drop of blood to be examined on a thin glass cover, and inverting it so that the drop may hang into the cavity of the cell, a perfectly air-tight compartment was formed, which prevented any evaporation from taking place, and the blood might be watched for some hours in a living condition. Although the blood of the newt coagulates immediately on touching a foreign body, this does not interfere with the movements of the white blood corpuscles. Those little bodies exhibit some very curious properties. They could be seen moving across the stage by means of the pseudo-podia referred to, just as the amœba do. One of the most remarkable facts about them is that they make their way out of the current of the blood through the walls of the blood vessels, and wander, as it were, amongst the tissues. A curious experiment made by Cohnheim proved this. If the swim bladder of a fish be filled with a solution of common salt, containing one per cent. of salt, tied and inserted under the skin of a rabbit or frog, after a short time, say twelve or twenty-four hours, it would be found filled by a large number of leucocytes, which had found their way into the bladder by permeating its walls. These were alive when they left the living tissue of the animal, but after going through the bladder their movements no longer continued, as they died in the saline solution; hence they were unable to escape from the bladder, and a large number become entrapped. This result not only applies to the swim bladder of the fish, for according to Cohnheim, if the cornea of a frog's eye be taken (it must be quite fresh) and inserted under the skin of a living frog, in the course of 24 or 48 hours it will be found upon examination to contain a large number of leucocytes at various depths in the tissue of the cornea. Mr. Lowne considered these to be very remarkable properties, and he laid much stress upon them as throwing a great deal of light upon the doctrine of *Pangenesis*, as enunciated by Charles Darwin—to which he had drawn the attention of the Club some time since—by which doctrine it was supposed that particles or gemmules were given off from every part of the organism, capable of reproducing like parts under certain conditions, and of being collected in the *ovum*. The whole animal was thus permeated by particles passing off from the living tissue. It had been objected by the President that these particles, being solid, could not pass through the walls of a living cell; but if leucocytes could pass through solid tissues he could not see why minute gemmules, which might be solid or semi-solid, like leucocytes, should not pass through cell walls. He could not see why there should be any serious objection to the doctrine of *Pangenesis*. There was great difficulty in distinguishing a solid from a fluid. If the *protozoa* be examined many of them would be found to exhibit a series of gradations of solid matter, harder externally and softer internally; but no lines of demarcation could be drawn between the solid and more fluid parts of those animals; as one portion of the protoplasm shaded insensibly off into another.

The President said he wished to correct any misapprehension that may have arisen with regard to some arguments which had been advanced by him in connection with the subject under discussion at the last meeting, and had been just referred to by his friend Mr. Lowne, who had suggested that because the white blood corpuscles could pass through the walls of the blood vessels there could be no objection to the idea that small particles of living matter (from the so-called nucleus) might pass through the walls of every cell in every part of the

body, and at every period of life; and that these small particles, having passed through the cell wall, made their way to the reproductive organs collected there, and combined to form an ovum or a spermatozoon. Not only did white blood corpuscles pass out of the vessels, but red ones also. But surely every one would admit that there was a great difference between the case of a white blood corpuscle passing through the vascular wall and the *supposed passage* of a particle of living matter *through a cell wall* many times thicker than the wall of the vessel, and in some cases very hard and dense. When the capillaries are distended their walls are stretched, and longitudinal rents or fissures result, through which blood corpuscles might escape. This point could be proved by artificial injection. With regard to the passage of the corpuscles from the capillaries, it must be borne in mind that the fact had been observed both by Dr. Addison and Dr. Waller long before Cohnheim wrote; while he (Dr. Beale) had demonstrated the passage of *minute particles of living matter* through the capillary walls before 1863.* One very important difference between his and Cohnheim's view consisted in this, that whereas Cohnheim's doctrine implied that every pus-corpuscle formed was once a white blood corpuscle, he felt sure that the pus-corpuscles grew and multiplied in the manner he had described, because he had seen some of the steps of the process. Probably one small particle of the living matter might produce multitudes of pus-corpuscles in a short space of time. He need only say there was a very serious objection to the theory of the pus-corpuscle being a white blood corpuscle that had traversed the vascular walls from the blood. If the number of the pus-corpuscles formed in an abcess in the course of 24 hours were estimated, it would be found to be greater than that of the white blood corpuscles existing in the whole body at the time. Reverting to the theory of Pangenesis, held by Mr. Darwin, and which Mr. Lowne had brought under the notice of the Club, he would not, of course, venture upon the profitless task of trying to upset that or any other favourite hypothesis advanced in the present day to explain facts of nature. All he could hope to do was to convince them that it was very improbable that the hypothesis in question would turn out to be correct. Taking into consideration the great thickness of the walls through which the living particles, according to the hypothesis of Pangenesis, must pass, and the difficulty of conceiving how such particles would find their way with unerring precision to their point of destination, and the nature of the forces which would cause them to combine and form a minute p. rticle of living matter, having the powers the sperm and germ are known to possess, he thought the idea not only a most fanciful one, incapable like many other fanciful ideas of scientific refutation, but absolutely destitute of the support of scientific evidence. Moreover, the author of the hypothesis had not discussed in detail the actual changes which he supposed actually occurred. His ideas of "cells" appeared thoroughly vague and ill defined. It seemed to him (Dr. Beale) very unreasonable that in order that we might accept the hypothesis of Pangenesis, we should be called upon to ignore the almost insuperable objections that might be advanced against it, and the same remark would apply to many a modern hypothesis. Who could believe that the processes alluded to were really going on in every cell, in every part of the organism, and at every period of life? The view was improbable, and the more the details were considered the more improbable it appeared. At the same time that he thought the doctrine improbable, he would not deny its possibility; and his object, in-

* "On the Germinal Matter of the Blood." Trans. Micr. Soc., 1863.

deed, was not to show that it or any other fanciful conjecture was *impossible*, but that many circumstances prevented us from accepting it as true, while the facts which Pangenesis was invented to explain were to be accounted for by another view which did no such violence to the reason as the hypothesis in question.

Mr Lowne understood the President to say that the blood corpuscles passed through the vessels by invisible longitudinal fissures ; he did not admit that such fissures existed, but if it were granted they did, what would be said of the German view of *pore* canals through which pangenetic particles might pass out of cells ? He could not see, also, the necessity that cells like those of dentine or bone should give off pangenetic gemmules in the adult state, because they had given them off while in a growing state, as such gemmules could inherit the tendency to reproduce older conditions, just as the children of young parents inherited the tendency to produce wrinkles and grey hair in after life, like those of their parents. Lastly he did not think any one could look at the solid and fluid portions of a cell and say where one began and the other terminated ; a fact easily observed in the *Protozoa* and *Infusoria*.

The President concluded as follows :—He had intended to have raised some objections to the terms employed by Mr. Lowne that evening. He considered one great object of the members of the Club was to reduce everything to its simplest possible expression. Many scientific authorities who had written during the last few years had altogether neglected this principle of simplicity in teaching natural knowledge. Why should the word *leucocyte* be used, instead of "colourless blood corpuscle," which was more correct, better known, and had a less harsh sound ? The word *leucocyte* would be recognised as being derived from two Greek words, signifying *white* and *cavity* or *cell*, but he was sure Mr. Lowne would agree with him in the statement that the interesting corpuscle in question was neither *white* nor was it a *cell*. The grand thing for the spread of scientific knowledge was, in his opinion, to employ terms as simple as possible, and he could not help thinking that if Mr. Lowne had, in referring to those bodies, used the expression "colourless blood corpuscles," or spoken of them as *bioplasts*, as being composed of *living*, *growing* matter, and *multiplying as all living matter did*, it would have been better. The term *leucocyte* was so austere that, like many others, it might deter students from enquiring further. It was very objectionable, and had already excited a desire to coin others equally so. A friend of his had suggested that to the corpuscles in the muscles of the body the term *sarcocytes* should be applied. This would give rise to *osteocytes*, *neurocytes*, *encephalocytes*, &c. Besides, as he had shown, the term *leucocyte* itself was a complete misnomer, for it had been applied to something quite colourless, that was not hollow, had no cell wall, and possessed none of the properties of the true cell.

APRIL 28th, 1871.—*Chairman*, DR. LIONEL S. BEALE, F.R.S., President.

The following donations to the Club were announced:—

"Land and Water," (weekly)	from the Editor.
"The Monthly Microscopical Journal," for April and May, 1871	the Publisher.
"Science Gossip"	,,
"The Popular Science Review"	,,
"Proceedings of the Bristol Naturalists' Society"	the Society.
"Journal of the London Institution"	the Librarian.
"The American Naturalist"	in exchange.
"Saturday Afternoon Rambles"	from Mr. Henry Walker.

The thanks of the Club were unanimously voted to the donors.

The President said that although there was no paper to be brought before the members that evening, he hoped that the meeting would be a pleasant and profitable one, and invited any member present to bring forward any subject of interest, or any topic which might tend to provoke discussion.

Mr. Henry Lee said, that as the club was originally started for the mutual assistance of its members in pursuing their studies, he would avail himself of this very important feature by stating a difficulty and asking advice. With all his experience in mounting—and it had not been small—he had found it almost impossible to close cells filled with glycerine, in such a manner as to prevent them from leaking; and as glycerine was such a valuable medium for mounting in, it became very important to ascertain if there was any effectual means of getting over this difficulty. He was in the habit of using a mixture of 4 parts of glycerine and part of camphor water, and sealed down the covers with gold size; but in consequence—as he supposed—of the expansive nature of the glycerine, in warm weather the cells nearly always burst, frequently to the very great detriment of the preparations.

The Secretary expressed his obligation to Mr. Lee for bringing forward this subject; there was no more valuable medium for mounting in than glycerine, but it had unfortunately this drawback, that it would leak out of the cells however carefully they were closed. He had at one time thought that a solution of gum dammar in benzole was proof against its action, but he had since found that it wou'd not stand, and notwithstanding the great care which he had taken the glycerine still leaked out; in fact it seemed, in time, as if it would dissolve any cement that could be used.

Mr. W. T. Suffolk said that he was one of those who had been extremely successful in keeping glycerine in. His plan was as follows: when the cell was closed he varnished it with a coating of common liquid glue, and when this was dry he put it under the tap, and thoroughly washed it in order to remove any glycerine which might remain outside. After carefully drying the slide with blotting paper, he gave it another coating of the liquid glue, and when dry repeated the washing process, and after having given it a third coating in the same manner, he gave it a final coat of gold size, and he had never had any trouble with cells closed in this manner. He believed that the secret of success in a great measure was owing to the washing; the gold size was also removed

from contact with the glycerine by the elastic varnish under it. Glycerine would do no harm to gold size when it could not get at it.

Mr. Henry Lee inquired if he understood rightly that Mr. Suffolk first sealed down his cells with gold size ?

Mr. Suffolk replied that they were closed with the varnish which he allowed to run under by capillary attraction.

Dr. Matthews said he had not found it necessary to use diluted glycerine, although he had successfully employed a solution of carbolic acid and camphor in glycerine. The best solution for closing the cells he believed was one of gum dammar in benzole diluted with gold size ; this seemed to be quite impervious to glycerine even undiluted.

The President asked what length of time Dr. Matthews had used this ?

Dr. Matthews said he had used it about a year. He was not sure that the presence of an air bubble in a cell was an evil, so long as it did not interfere with a view of the object, because it served as a spring to counteract the pressure arising from the expansion of the glycerine. Whenever in mounting he had enclosed an air bubble he found that it caused no harm, and he was inclined to regard it as an advantage.

The Secretary observed that as Mr. Hislop had mounted a large quantity of very excellent slides in glycerine, he hoped he would give the meeting the result of his experience in the matter.

Mr. Hislop said that his experience was that of Mr. Suffolk, for he had found no difficulty in keeping in glycerine. His plan was to make a good seat for the cover, first by a thick ring of gum dammar, allow this to become sticky, and then put in the glycerine, lay on the cover, and then carefully wash off all superfluous glycerine. When perfectly washed and dried put on two or three coats of gum dammar to finish it. He had in this way mounted slides which had kept well for more than two years, and he strongly recommended gum dammar for the purpose. Care must be taken that the glass was perfectly clean, and if this were attended to, and a good bed was made of cement on which to place the cover, there would be no doubt as to the result. He had some large preparations—such as a whole frog or toad passing from the tadpole condition—which had been put up in this way, and they were perfectly intact, and not the slightest exudation had ever been observed.

Dr. Matthews mentioned that it was from Mr. Hislop that he derived the idea of making a ring upon the slide ; in doing this it was necessary to wait before putting on the cover until the gum dammar became "tacky," because if this were not done it would be found that tears of dammar would run in and spoil at least the appearance of the slide around the edge. If, after making the ring, the slide were put aside for an hour before proceeding to mount, there would be no danger of this occurrence.

Mr. Hislop stated, in reply to a question from Mr. W. Hainworth, that the gum dammar was used also as a substitute for marine glue in attaching cells to slides.

Mr. Tafe was of opinion that time and care were the chief secrets of successful mounting.

The Secretary suggested that as liquid glue was found to answer so well by Mr. Suffolk, it would be well to try a solution of shell lac in benzole, which would no doubt be found to dry off more quickly.

Mr. Suffolk expressed a doubt as to whether shell lac was soluble in benzole. He also said that as it was of the greatest importance that the slides should be

quite clean, it might be useful to members to know that a solution of bichromate of potash in water, with the addition of some sulphuric acid, was a very excellent cleaning fluid. The proportions to be used were—bichromate of potash, 1 oz., sulphuric acid, 1 oz., water, 1 pint; it would be found to take off all kinds of dirty stains, and was especially useful where the slides had previously been used for balsam.

The Secretary inquired whether it would take off old balsam from slides?

Mr. Suffolk replied that the balsam should be taken off first by putting the slides into soda, and then the slides could be cleaned off afterwards with the fluid.

Dr. Matthews recommended a strong infusion of nut galls as a very excellent thing for cleaning glass slides; it cleaned them chemically and not merely mechanically.

The Secretary said it was a very great nuisance, cleaning off old balsam from slides, and he was very glad to learn how it might be done without much trouble.

Mr. B. D. Jackson had found a mixture of distilled water, alkali, and tripoli very useful for cleaning glass, especially where a little friction was of no consequence; he would be glad to communicate the formula for making this mixture to any member who desired to try it.

Mr. Henry Lee expressed his thanks for the information which had been given; he had never in mounting thought either time or trouble to be an object, as he always desired to do the thing well, but then the thing was *how* to do it. He thought it would not be out of place to say that he should like to see the meetings of the Club return more to their old conversational style than had latterly been the case; he thought all would agree with him that the evening had not been less pleasant because they had no paper read, and he believed it would be better for the Club on the whole if they aimed less at scientific than conversational evenings.

Dr. Matthews said that it would no doubt be remembered that at the last gossip meeting he showed some turkey parasites which were mounted in such a way as to be unusually transparent, and yet showed all the internal structure in a very perfect manner. He had since then been asked how this was done, and he wished to say that he first placed them in weak spirit and water, then transferred them to stronger spirit and water, and afterwards to strong turpentine, and after remaining there a sufficient time he mounted them in balsam. They were not treated with liquor potassæ or any other destructive fluid, and hence the entire system of trach were preserved intact and were shown in a remarkably clear and beautiful manner.

Mr. Henry Lee asked if they were not rendered stiff and difficult to lay out after being prepared in this way.

Dr. Matthews said they were not at all so, and the method he had described showed the structure so admirably that he most strongly recommended it.

The President said that he quite agreed with Mr. Suffolk as to the necessity for extreme care and cleanliness in mounting objects in glycerine. He thought, however, that the manner in which the varnish was applied to cement the thin glass cover, had more to do with the preservation of the joint than the nature of the varnish used. Fifteen years ago he had employed for the purpose common Brunswick black, improved by adding a little solution of indiarubber in coal naptha. When this was dry the edges were very carefully wiped before putting on another layer. Several layers were subsequently applied, an interval of a day

being allowed to elapse between the application of each. Some of the slides so prepared had been in his possession for fifteen years without any failure of the cement, and without the entrance of an air bubble. Some of them were of large size—*i.e.*, $\frac{1}{8}$-in. thick and from 1-in. to $1\frac{1}{2}$-in. in diameter. He had also used Bell's cement, which consisted, he believed, of boiled oil, shell lac, and spirit of wine; that answered very well, and he had a large number of specimens which had stood for a great many years and were still perfectly tight, and the included specimens in a satisfactory state. Another fact worth mentioning was, that the best results were obtained by using the strongest glycerine for mounting, for it was found that diluted glycerine would get through the cement much more easily than very strong glycerine.

In reply to a question from the Secretary, the President said that he soaked up any excess of glycerine with blotting paper. It was a good plan to draw a ring roughly upon the glass slide with a common rough diamond point. In this way a kind of trough was formed, into which a little of the cement would run and dry, and it would be found that the cement would adhere with greater tenacity to those parts of the glass which were scratched or roughened than to the polished surface.

The following objects were exhibited :—

Section of Stem of Potamogeton natans ...	... by Mr. W. J. Brown.
Ferricyanide of Potassium, &c.	... Mr. Golding.
Gemmiparous conceptacle of Marchantia ...	... Mr. Jackson.
Polyxenus Lagurus (in fluid)...	... Dr. Matthews.
Falx of Spider	... Mr. J. Smith.
Circulation of blood in tail of Tadpole ...	... Mr. Tafe.
Also a portable Microscope	... Mr. Richards.

May 26th, 1871—*Chairman*, Dr. Lionel S. Beale, F.R.S., President.

The following donations to the Club were announced :—

"Land and Water," (weekly)	... from the Editor.
"Science Gossip"	the Publisher.
"The Chemist and Druggist"	the Editor.
"The American Naturalist," Nos. 2 & 3., vol. 5	in exchange.
1 Slide	Mr. Jackson.

The thanks of the Club were voted to the donors.

The following gentlemen were balloted for and duly elected members of the Club :—The Revd. Robert Balshaw, Mr. Francis A. Bedwell, Mr. George Browne, Mr. Robert Catchpole, Dr. R. Coales, Mr. Frederick Enoch, Mr. Thomas E. Freshwater, Mr. C. H. Hinton, Mr. John Locke, Mr. John W. May, Mr. Charles Oriel, the Revd. William A. Paxton, Mr. Edward P. Pett, Mr. E. Richards, Mr. J. S. Sigsworth, Mr. Henry Stapleton, Mr. William C. Unwin, Mr. James W. Williams.

Mr. B. D. Jackson described and exhibited to the meeting a new form of paraboloid, on the immersion principle, for which several important advantages were claimed. It differed from the ordinary forms in use by having a slightly concave emergent surface (instead of the usual cup-shaped hollow), which

secured it from danger of being scratched by contact with a slide passed over it. In using the ordinary form of paraboloid, a great portion of the light was totally reflected by the slide, upon the stop, causing a partial illumination of the field, which appeared of a neutral tint instead of black; but by the use of the new paraboloid, this reflection was entirely prevented, and the object received a much greater degree of light than it could in the ordinary way. The curves of this paraboloid were worked up for a particular thickness of glass; and if the slide to be examined differed from this, it must be padded up with pieces of thin covering glass in the same way as proposed by Mr. Wenham. One of Moller's diatom slides, mounted in balsam, was exhibited in the room with one of these new paraboloids for the inspection of the members.

Mr. Hailes inquired in what respect, and why, the curves of this paraboloid had been altered?

Mr. Ackland (from whose formula the paraboloid had been constructed), replied that the object of the alteration was to avoid the reflection of light from the under surface of the slide. The upper surface of the paraboloid was very slightly concave, being on a radius of 30 inches; but the construction was very different.

A vote of thanks was unanimously passed to Mr. Jackson for his communication.

Mr. James Smith exhibited to the meeting a simple contrivance designed to obviate a difficulty frequently met with in using Ross's 4 in. objective, in consequence of the great length of focus required. It consisted of a small mahogany sub-stage, attached to the wooden stand of the microscope, and jointed so that it could be set at any angle required to make it parallel with the ordinary stage when the body of the instrument was inclined. The object to be examined was placed upon the sub-stage, and viewed through the orifice in the upper stage, by which means an ample length of focus and a great degree of steadiness were obtained. For the illumination of opaque objects in this position, the concave mirror was admirably adapted, and the lamp did not, in that case, require to be placed so near to the instrument as to cause any inconvenient amount of heat to the observer. The habits of living insects could be most advantageously studied by this arrangement; and he had recently observed, when examining a spider, that, in attacking a fly, and enveloping it in a quantity of web previously to finishing his meal, a silken thread was spun from each of the five spinnarets, instead of from one only, as under ordinary circumstances.

In reply to a question from Mr. Curties,

Mr. Smith said he had not yet made any provision for examining objects by reflected light; but he intended shortly to give his attention to this, and thought that it might be accomplished very easily.

Mr. T. Crook suggested that a piece of plain looking-glass placed upon the wood stand would answer the purpose.

Mr. Golding thought that the small round looking-glasses sold at toy shops for a few pence were all that could be required.

Mr. Smith said that, although he had contrived this arrangement, especially for a 4in. objective, it would answer equally well for a 3in., or even for a 2in.

Mr. E. Richards thought it would be a great addition to the arrangement if the front lens of the objective were made to draw out. He also suggested that Reade's prism would answer very well for the illumination.

The President said he would offer one more suggestion in addition to those already made. Would it not be possible to arrange the instrument in this way

so as to act as a dissecting microscope? As such, it would, no doubt, be very convenient, both as to its steadiness and in having the ordinary stage and other parts quite out of the way of the hands.

Mr. Smith thought it might easily be adapted for that purpose, and believed it would be very useful.

A vote of thanks to Mr. Smith for his communication was carried unanimously.

Mr. Richards then introduced to the meeting a simple addition to his portable microscope body, being a small brass clip, by which it could be fixed to an upright pillar stand, whilst a swivel joint allowed it to be freely moved to any required inclination. He had designed it, knowing that it was a matter of trouble and difficulty to bring a large microscope to the meetings, and believing that, in nine cases out of ten, his microscope, mounted on the pillar stand, would show any object required.

The Secretary said that they had to thank Mr. Richards, not only for his communication, but also for a donation which did not appear upon the list. As many members of the Club who had these microscopes had also purchased the clips, Mr. Richards proposed to present the Club with some of the stands, which would be thus available for the use of anyone who brought microscopes to the meetings. He could, from personal observation, say that this form of microscope was very valuable when used for examining insects in one of Mr. McIntire's cork cells, and he believed it would be very useful as a tank or aquarium microscope. At the recent meeting of the Royal Microscopical Society, he saw Stephenson's Binocular erecting microscope with a glass cap placed over the objective, and put into a tank; it was merely a closed glass tube with a brass collar screwed on the microscope over the object glass, the end of the tube being closed in with a circle of thin covering glass, and he thought that if some such contrivance could be adapted to this microscope of Mr. Richards', without infringing in any way upon Mr. Stephenson's rights, it would be a very valuable addition.

A vote of thanks to Mr. Richards for his communication, and for his donation, was unanimously carried.

Notice was given by the President that the nominations of gentlemen to fill vacancies on the committee must be made at the next meeting, and members were desired to come prepared with names for proposal. The excursionists' annual dinner was also announced to take place at Leatherhead, on June 22nd.

The proceedings terminated with a conversazione, at which the following objects were exhibited:—

Various Foraminifera	by	Mr. Hailes.
Eupodiscus Argus, shown with $\frac{1}{4}$in. objective of 110° angular aperture and new paraboloid	,,	Mr. Jackson.
Trichocephalus dispar	,,	Dr. Matthews.
Podura Scale, shown with an immersion $\frac{1}{8}$in. objective, having a double adjustment for correcting the chromatic aberration.	,,	Mr. Thos. Powell.
Live Insects, shown with 4in. objective and new sub-stage	,,	Mr. Jas. Smith.

Microscopic Work and Conjectural Science,

Being the Address of the President for the Year 1871.

(Read July 28th, 1871.)

This day our Club enters upon the seventh year of its existence. It began with eleven members, but now more than fifty times that number are enrolled. May it steadily progress, and may its usefulness increase with its success! Founded in memory of one whose whole life was devoted to the prosecution of those branches of natural knowledge in which the microscope has done good service for more than a century, our Club is a club for promoting practical microscope work among its members. Quekett worked, as only a thorough student can work, without affectation, simply, generously, carefully, unremittingly.

The Quekett Club works on incessantly, and rests by changing the character of its occupation. By ordinary meetings, gossip nights, excursions into the country, its activity is unceasing, and the vigour of its health is continually renewed as it increases in age. It needs no holidays, though it never rests; for it recruits its energies while it continues to labour, and it never gets tired, because it frequently changes its work. Such have been the wise enactments of the founders of our Club, and every year confirms the wisdom of the principles which they laid down, for not only are these now accepted by nearly 600 members, but several new clubs, conducted on the same plan, have been established in every part of the country, and are eminently successful.

Though so numerous, we could find work for many times our present numbers. No microscopical research, however complete, was ever brought to a conclusion without the necessity for labours tenfold as extensive being demonstrated. Though little acknowledged, minute research is at this time performing no unimportant part in intellectual advancement, and by its aid such great changes in thought may ere long be effected as are not dreamt of in the

popular philosophy of the hour. Let not the student of nature be discouraged by the taunts of those who think to evolve a new artificial nature from the recesses of their consciousness, who consider themselves privileged to substitute for facts of observation fairy fancies of the imagination.

Proclaiming an intense distrust of all that does not rest upon positive evidence, the strong brethren of the new philosophy try to force us to accept, without examination, the dogmas of a conjectural mist science positively negative in its tendency and character.

Compared with the rapid flight of many a physical aspirant it may be truly said that the progress of the microscopical observer is terribly slow. Moving onwards at a snail's pace, but still onwards, we have, alas, little to attract the mere sightseer, nothing to dazzle or excite the listless and languid in search of some new sensation, nothing to amuse those who are exhausted by their enervating anxiety to discover something worth seeing or doing that does not necessitate the painful effort of working or thinking. But we must submit to this disadvantage. Our work teaches us patience, and enables us to bear unpopularity. By prosecuting it we learn to avoid endorsing hasty decisions, which might gain for us the applause of the public, but would certainly retard science; and at the same time we learn to work on quietly, but steadily. The veriest tyro in microscopic work soon becomes conscious that there is more to learn than he can ever hope to discover, if he work unremittingly and a long life be granted to him.

Some, by concentrating their attention on one department of microscopic research, add vastly to our knowledge, but the most talented soon reaches a standpoint from which he discerns ever increasing fields requiring careful examination. He looks forward to never-ending labour in which he cannot take part, and to never-ceasing discovery in which he is not to participate, and which he can never know.

But in these days not even the humble microscopist is permitted to work in peace. His conclusions are unceremoniously tossed aside in order to make way for conjectures of the fancy, and his labour fields are invaded by the reckless and ambitious who profess to despise his careful quiet way, though jealous of the results he may perchance achieve by the aid of the instrument he loves.

Ignorant of his implements and of the methods of using them,

incapable alike of working in the spirit in which he works, or of comprehending the bearing of the facts he demonstrates, some physical authorities have lately tried to set aside the truths already established, have spoken contemptuously of microscope work and workers, and have endeavoured to persuade the public that other kinds of investigation are superior to microscopic enquiry, and may be advantageously substituted for it; but, as might have been anticipated, disaster has resulted from these misdirected efforts. If certain brethren of the scientific workshop speak of themselves as *strong* and of the rest as *weak*, and then endeavour to oust the latter, it is not difficult to foresee the result; real work will be suspended, workmen discouraged, and confusion will reign supreme. Instead of the strongest party gaining for themselves, as they hoped, all the credit due for work done partly by them and partly by their fellow workmen, the work of all is mistrusted and set aside until it can be more thoroughly tested and examined, and the bad work distinguished and separated from the work that is good. In the meantime many labourers remain idle, and out of work, and it is long before peace and harmony are restored.

The attack recently made, by physical force, upon our active, living, growing department of the scientific workshop, was as unjustifiable as it was unprovoked, and it was inaugurated in misconception. Physical force, we were told, would perform and account for everything, and supersede entirely the necessity for careful and very minute enquiry into the structure and changes of living things. It was to save us trouble, and it was to open a royal road to knowledge. Unfortunately, we listened too readily to the voice of the charmer, and bitterly have we suffered thereby. He has wasted our time, blinded us with the dust he has disturbed, and all he has shown us is that he was utterly unacquainted with the very elements of our work. He proceeds with great confidence in his physical powers to examine the dust he has succeeded in raising, and begins by declaring that nothing was known concerning the nature of dust before the subject was illumined by the light of his own particular physical investigation. Thus it happened that dust became of the greatest importance in a physical sense, and for many months past the great dust question has taken the very first rank among subjects of serious consideration, and has even on some occasions excited as much interest as political conversation formerly did in advanced intellectual society.

One would have supposed that of all things in this world, dust was one that might be profitably studied with the aid of the microscope, and that its investigation belonged to the province of the microscopic observer. Indeed, it was pretty generally known that dust had been very successfully investigated by many microscopists; but the results were to be put aside in order that a new philosophy of dust might be preached. Dust, it was shown, must be re-studied from the very beginning, and last year it was formally announced that up to that time the world had made a very grave mistake in supposing that the dust of its air consisted of inorganic matter. The world had been in error, and was then to be enlightened for the first time. The dust particles were not to be shown under the microscope, because, in this way, the great question would have been settled at once, in which case there would have been no real philosophy of dust. People would have seen the various particles composing the dust, the bits of hair, and feather, and cotton, and wool, and starch, and fungi, and other organic matters, as well as the soot and particles of sand and other inorganic substances. These would have been demonstrated, as in a moment, and might have been exhibited to all. True, generations of microscopic observers had already studied dust, and had figured over and over again the organic matters lately, for the first time, supposed by physical authority and the world, to be absent from dust; but it was urged dust had never been properly illuminated before, neither had the terrible morbific properties of dust been assumed until that time. Thenceforth the great dust question became of painful, of thrilling interest, and everyone asked his neighbour if he had heard the last new discovery in dust. Then came the consideration of dust in the air, dust in the water, dust in the sick room, dust at rest, dust in motion, rising dust, and falling dust, filtered and precipitated dust, life-giving dust, life-destroying dust, fever dust, ague dust, cholera dust, ponderable and imponderable dust, cosmic dust, comet dust, cloud dust, and sky dust; dust of the imagination, dust historical, dust poetical; dust to be burnt, dust to be suspended, dust to subside, dust to be dispersed, to be collected, to be separated, to be studied and contemplated, and looked at in every way, except through a magnifying glass, for by that simple operation, the whole nature of dust was to be ascertained for once and for all; its organic constituents distinguished from its inorganic ingredients, the

living particles it contained, as well as the lifeless ones. But for this a microscope would have been needed, and a microscope is a most *mischievous instrument.* Besides which, it seemed clear that the philosophy of dust could be discovered only by the aid of physical and chemical investigation. The microscope, it was suggested, was quite useless here, for had not glass a distinct structure which the microscope had entirely failed to discover. How, therefore, could that unfortunate instrument be of the slightest use in the investigation of dust? The microscope was very properly condemned by physical authority, and microscopic observers were called names not calculated to gain for them the respect of unscientific people.* But great was the applause which followed, and the superiority of physical investigation over microscopic observation for the elucidation of dust was admitted.

The elevation of one branch of scientific investigation at the expense of another, would not have been so successfully achieved if the public had been better informed. The authority who disparages one mode of scientific enquiry, in order to gain an increased share of approbation for the particular method which he pursues, though he may gain applause for his prowess, will not raise himself in the estimation of well-informed persons, and as time goes on, his apparent cleverness will provoke more than disappointment. In a battle of science, physics would no doubt dominate, for is it not acquiring mighty force by variation and selection? When it shall have gained the dominion it covets, it will be able to proclaim its admirable fitness for solitary survival, to the inanimate waste over which it will reign supreme.

Is it not time that we who study the phenomena of the minute, should explain to the people what we have seen. It is only by the aid of our miscroscope work that man can learn the structure of his body or form a correct notion of the wonderful actions going on in the atom worlds of which it is constituted? Many have, perhaps, been so deeply interested in the pursuit of microscopic labours that they have hardly cared to force themselves and

* "In the 'Prefatory Letter' to his 'Lay Sermons,' Mr. Huxley speaks of 'Microscopists, ignorant alike of Philosophy and Biology.' With reference to one conspicuous member of this class, a doctor of medicine, lately professor in a London College, famous for its orthodoxy, both Mr. Huxley and myself have long practised, and shall, I trust, continue to practise, the tolerance recommended above!" "Let us tolerate those, and they are many, who foolishly try to support or oppose the evolution hypothesis!" The "Scientific (!) Use of the Imagination," by John Tyndall, LL.D., F.R.S., page 49. 1870.

their work before the public; but surely it would be well if the public were better informed concerning the structure of their own bodies, and from microscopists themselves, for then people might see and judge whether or not they were the wretched force-made instruments the physicists hold them to be. For years past our physical masters have been arrogant, rather positive, and very prophetic as to what was about to be discovered in the future, but their arrogance has not gained for them confidence, and is effecting its own cure; their positivism is discovered to be but a very monstrous nihilism in disguise, and their prophetic spirit is dying out in disappointment and distrust.

It is wonderful what haphazard assertions are made in these days concerning the likeness or identity of dissimilar things. Observers, who should test these assertions, and ascertain whether they are accurate or not, permit them to pass without comment, and the public accepts them as literally true. We are told, for example, by Mr. Darwin that it is "scarcely possible to exaggerate the close correspondence in general structure, in the minute structure of the tissues between man and the higher animals, especially the anthropomorphous apes." But Mr. Darwin does not tell us that he or anyone else has made the observations upon which the statement is founded. A careful comparison of the tissues of man with the corresponding tissues of apes in minute structure is much to be desired, but it has never been made, and it is quite premature to speak of the supposed "close correspondence" as if it had been proved to exist. As to the close correspondence in chemical composition, asserted to exist between man and apes, the same remarks may be made. Such correspondence has yet to be shown.

Again, arguments concerning the action of the nervous system have been based upon the assumption of the existence of a peculiar colloid isomerically transformed with ease, but the peculiar colloid and its isomeric transformations have yet to be rendered evident to the senses. And who has not heard of the likeness between the embryo of man and the embryo of the dog, and of the grand conjectures founded upon the likeness existing at a certain period of development? But what if the embryos be compared at a still earlier period of existence? The likeness will in that case be found to be so very great that one embryo could not be distinguished from the other. Surely a philosopher who pondered

on these things with the "calm indifference of the wise," would desire to go further than a superficial comparison of the points in which two things seem, to the unaided eye, to resemble one another. Would he not search, also, for the characters in which they might differ? and would he limit his observations to one particular period of development only? Not till he had studied the question from all sides and well considered the bearing of many different facts would he commit himself to any general doctrine. But, alas, in these days there is not time for all this, and the only philosophical way is to prove how very like one thing is to another, and then affirm that this likeness is conclusive in favour of the conjecture that both were derived from a common ancestor. Not only are the differences between the two wider than has been supposed, but the resemblances, at an earlier period of development, are very much greater. The argument from likeness may be made to tell against the doctrine in support of which it is advanced as well as in favour of it. But does it never happen that two things which appear like to one pair of eyes, seem to be very unlike when examined by others? And some might suppose that of all persons likely to be able to form a fair judgment upon so delicate a matter, the microscopical observer by his training would be probably the fittest. He has been accustomed to look for minute differences, his eye has been well trained for detecting minute points of difference between things that resemble one another generally—but, then, authority will ask with indignation, "Is not a mere microscopist hopelessly disqualified for such a task?" He who carefully studies minute details will soon find that many of the arguments now regarded as conclusive in favour of reverting to an extinct philosophy are of little worth. Conjectural Philosophy, however, seems to conclude that an investigator who foolishly allows himself to be influenced in the least degree by the events and lessons of the past, except of the very remotest past, should not be noticed in any way—that prejudges himself, and any opposition to the advanced views from a person so disqualified, ought not to be listened to for an instant and that the tendency of thought demands the forcible suppression of all facts and all arguments which do not accord with advanced views on mechanical cerebration, and the evolution of self-multiplying mechanisms from the collocations of passive material particles.

You will, however, find that the physical intellect is eminently

sensitive. A word in opposition will sometimes produce the most terrible results, but there is one word which causes the utmost distress. You may talk of molecular pulsations, and vibrations, and collocations, and differentrations and the like ; but if you once make use of the term *vitality* or *vital*, you are lost for ever, and become the subject of physical contempt or physical scorn, and are regarded as a sort of scientific outcast, beyond the pale of physical civilization, and unworthy of material sympathy.

Nor is it very strange that in some very positive expressions of opinion concerning the nature of life, the origin of living beings, and the formation of species, the results of microscopic observation should be altogether ignored. Perhaps the facts gleaned by the aid of magnifying glasses are not favourable to the general doctrines which have been recently taught by physicists who have faith in the evolution of living things from non-living matter. In these days when the highest feeling which man can experience after years of true devotion, is said to be something like the love of a dog for its master, or a monkey for its beloved keeper —when all intellectual action is reduced to mere molecular vibration, and when the moral sense is believed to be identical with the social instinct, there is, I fear, little chance of exciting interest in the study of mere structure. The man who suggests, ever so gently, that many of the grand generalizations of which we are now so proud are founded on statements that have never been put to the test of observation, will certainly be characterized as a presumptuous person, unworthy of consideration. And yet it is obvious that every fact upon which these conclusions are based should have been carefully examined, and the reasoning analysed step by step. I dare say that the doctrine that in the struggle for existence, he who survives is unquestionably the fittest, affords consolation to the victims about to be extinguished, and more than compensates for the questionable advantage of surviving enjoyed by others upon whom has been imposed the duties of executioner by the benign influence of natural selection; but it is surely worthy of enquiry how far the facts upon which this grand conclusion is based may be otherwise explained, since there is no reason for regarding the doctrine as final, and further investigation superfluous or sealed.

"Both bodily and mental processes are correlated with the natural agencies of heat, light, electricity, chemical affinity, mechanical force, and gravitation," is a dictum now generally believed, but

very very far from being proved. By the help of this sort of dictatorial assertion, it is now proposed to determine conclusively the nature of thought, and to supersede the necessity of studying the mere structure and action of the anatomical elements of which the organism consists. Mental action, and the comparatively low ordinary phenomena of life are thus disposed of—" The very highest condition of life, the most vigorous condition of health, is that state in which death of the particles of the body is most rapid and continuous, for the very force which we make use of in willing, reasoning, and perceiving is primarily derived from the chemical union of the tissues with oxygen, which has been compared by Baron Liebig to the falling weight by which the works of a clock are kept in motion." The dexterous framers of such convincing statements, encouraged by public approval, will continue to produce them, and innocent readers will accept them as eloquent expositions of the " tendency of thought." A mere microscopist may have the impertinence to endeavour to analyse the high-flown language, and to try to find out what meaning can be extracted from the grand and broad views which look so imposing, and astound the simple and unlearned; but are not physicists scientific prophets, who alone have power to regulate and govern public opinion in all matters relating to the science of the future? And would it not be very presumptuous to reason with a prophet, and monstrous to suppose that under any circumstances he could modify his opinion? Privileged prophets have affirmed that it will ere long be positively proved that the phenomena of things commonly called living, really do depend upon the collocations of the compound molecules of which they consist, and that these and their combinations are due to the properties of the ultimate constituent elements combining under certain fixed external conditions in obedience to unalterable laws.

But history will have to record in these days of fact and law inexorable, when physical science was taught in village schools, and physical philosophers ruled supreme in society, that certain Fellows of the Royal Society associated themselves with a so-called " medium " to investigate the so-called spiritual phenomena, and to consider whether table turning and chair lifting, and accordion playing, without the action of the medium's muscles, was or was not due to "psychic force." The details you will find in a journal called the " Spiritualist," where, I regret to say, you will also notice the statement that Mr. Alfred Wallace, the naturalist, the

intimate ally of Darwin and Huxley, is an "avowed spiritualist." What an avowed spiritualist may be I know not, but under the directions given to form "spirit circles" I find that "people who do not like each other should not sit in the same circle, for such a want of harmony tends to prevent manifestations, except with well developed physical (!) mediums. It is not yet known why belief or unbelief has no influence on the manifestations, but an *acrid* (!) feeling against them is a weakening influence." "A prayerful, earnest feeling among the members of the circle is likely to attract a higher and more pleasing class of spirits," and there is much more that I will not quote. Here indeed is a commentary upon the materialistic tendencies of the age, humiliating and painful enough.

But I think, gentlemen, I have said enough to excite in your minds a desire to examine into some of the curious doctrines believed in in these days. Many think, and I am among that number, that some of the views rest upon a most misty foundation, which requires and deserves the most thorough scrutiny, and I hope that you will not be deterred from submitting it to careful microscopic observation, and report fully the state in which you find its minute structure.

If members of our Microscopical Clubs and Associations would test the accuracy of the observations of original observers generally, the ends of science would be promoted. Errors would be detected and exposed, and truths confirmed. Observers would themselves be more careful. But if this were done there would also soon be an end of that miserable system which is now so damaging to science—the expression of strong opinions against real honest work on the part of those who are utterly unqualified to judge of its merits. In these days prejudice is excited against certain departments of scientific work in an unfair, underhand manner, that cannot always be met. Fundamental facts concerning structure are denied, the truth of which could be proved by the examination of actually existing specimens. There are some who, never tired of making a great to do about the FACTS of science, really hate facts if these happen to tell in favour of a view opposed to that to which they have committed themselves. Pretending to venerate fact, they will really only tolerate conjecture. This unfortunate state of things, inimical to the true interests of science and paralysing to progress, can only be corrected by the examination

and re-examination by disinterested observers of the facts on which the conclusions of those who have committed themselves to a particular view are supposed to be based. Every real worker longs for the thorough re-investigation of what he has done, for he repudiates the dictates of authority, and the support of parties, whether urged in his favour or with the object of correcting him. He disclaims being an authority, and refuses to submit to a scientific dictatorship of any kind, however absolute, potent, and uncompromising may be the power conferred by the accident of circumstance or by the influence of an infallible conclave. Is it likely that an intellectual tyranny will be less hostile to human progress than any other form of tyranny to which man has been forced to submit by his would-be benefactors in the times that have past? The dogma of evolution may be proclaimed infallible by those who have faith in it, as the only true hypothesis, and the only one fitted to survive; but, alas, in defiance of all laws known or licensed to be discovered, new hypotheses will appear, and by natural selection may gradually accumulate advantages which will at length enable them to compete successfully in the struggle for existence. It will, therefore, be prudent to strangle all new hypotheses at the birth, unless it be possible very soon to discover means by which the external conditions of existence may be so modified as to render impossible the collocations of atoms and molecules from which their forces and their characters are derived.

On the Examination of the Surface Markings of Diatoms by the Oxy-calcium Light.

By N. E. Green.

(Read 23rd June, 1871.)

My attention was called to the vexed question of the nature of the markings on diatoms, by an observation in a pamphlet on the use of Mr. Read's prism, in which the direction of light reflected by it was compared to that of the sun on the surface of the moon. The want of exactness in this comparison surprised me, for in using the prism, the rays of light are directed through a transparent object, whereas, in the case of the sun, they fall upon an opaque surface. However, the simile had something attractive in it, and knowing that minute markings on the moon's surface are best seen when the direction of the light is tangential, as at half moon, I determined to examine the surface markings of diatoms by side light, employing oxygen in order to secure a sufficient amount of illumination. The resolve was also made to avoid all mediums and glass covers, so that nothing should interfere with direct vision. Operations were commenced on a specimen of Isthmia nervosa, which was cut out of a dry slide, and mounted on a stand to raise it about an inch above the level of a stage, in order that a small condenser might be placed close to its side. The lime light was then brought to the level of the object, at about six inches from the stage, and a beam of intense light thrown across the surface. A valve of Isthmia was examined first with a $\frac{1}{6}$ by Ross, and afterwards with a $\frac{1}{12}$ by Gundlach. The surface presented a most remarkable appearance, being studded with rows of small shallow craters, the sharp edges of which projected slightly above, while the centres seemed to be below the surface. A friend who was present, exclaimed—"Why, 'tis like a nutmeg grater." The craters on one portion were alternately large and small, and in another part divided into petals like a flower. At the side of the valve the

forms were slightly hexagonal, though still maintaining the crater-like form. (See fig. 1.) Biddulphia, Triceratium, and a form allied to Coscinodiscus were examined in succession, and all yielded the same characteristic markings. (See figs. 2 and 3.)

A slide of Isthmia, mounted in the usual manner for viewing by transmitted light, was then placed on the stage and examined by light reflected from the mirror; but no evidence of the existence of the craters could be obtained. True, there were markings in the same places, but they appeared as projections rather than hollows, and no arrangement of transmitted light gave any hint of their true form.

The next object submitted to the test of side illumination was P. Hippocampus. A drop of water containing several specimens of this and other diatoms in the living state, was placed on glass, and the water allowed to evaporate. Here an entirely different kind of surface was observed. The lime light brought out most distinctly the bead-like character of its markings; they stood out in bold relief, like rows of Indian corn. (See fig. 4.) And this bead-like surface was seen also on Cocconema, and a few others on the slide. (Fig. 5.)

By the kind attention of Mr. Wheeler, of Tollington Road, I have since been supplied with many specimens of Naviculæ (mounted dry on slips of glass and uncovered). Of these, P. Acuminatum, P. Formosum, P. Elongatum, P. Balticum, and P. Angulatum have all given the same results, though the size, form, and projection of the beads differ considerably in the various kinds.

In Formosum the beads are smaller than in Hippocampus, and by no means so boldly relieved; indeed, at the edges of the valve there is a considerable flatness in their shape. In the case of Angulatum, when first submitted to the test of side illumination, the strong resemblance to its appearance when examined by transmitted light was somewhat surprising. There were the usual file-like markings, and even the hexagonal form was intimated; and it was only after the most careful adjustment of the light that a beaded appearance was brought out. A most interesting fact was observed in a valve of Angulatum, from which the coating of beads had been partly removed by abrasion, leaving portions still adhering like bits of bark on a tree. At the edges of these, the beaded form was more easily perceived than in the uninjured portions; there was evidently a thickness in the coating of beads, and this thickness was decidedly

greater than the projection of one bead from another. (See fig. 6) If this observation be correct, an important fact is developed in connection with the form of these beads or pellets in P. Angulatum, viz., that the curved top of the pellet surmounts some other shape, which may be cylindrical, but in all probability is hexagonal —at least, at the point of contact with the smooth surface of the valve. If so, the old and now somewhat rejected idea of the hexagonal markings may be true after all. Let us examine this supposed form by the appearances presented during the operation of focusing. When a valve of P. Angulatum is viewed under a $\frac{1}{12}$, in the usual manner by transmitted light, as the object glass is gradually brought down upon it, the first set of markings that the eye can recognise as being in focus, are a series of ghost-like dots, very small and evanescent; they come and go with the least touch of the slow movement. A little nearer, and rows of dots of a decisive character are seen; these are followed by hexagons, which maintain their form for some time, then pass into a second series of firm dotted lines, and finally the ghost-like points show for a moment, and all is gone. Now, comparing these appearances with the facts revealed by side illumination, we may arrive at this solution :—The first faint dots are produced by the tops of the pellets, the firm dotted lines by the shades of their sides ; the hexagonal form is due to the shape of the pellet at its contact with the plane surface of the valve, its continuance being accounted for by the repetition of this shape in the pellets on the other side (see fig. 7); the second series of decided dotted lines is produced as before by the shade on the side of the projecting portion of the pellets, and the last faint set of dots by the summits of their curved surfaces.

It should, however, be observed with regard to the amount of curvature in the top of the pellet, that although the powers employed, together with the illumination by the lime light, brought out in the most unquestionable manner the beaded surface of Hippocampus, Cocconema, and Cymbella, &c., and even exhibited it on such minute forms as Cluthensis, it required the greatest care, both in handling and in seeing, to produce it in Angulatum.

With regard to side illumination and reflected light *versus* under illumination and transmitted light, the first is valuable only for *surface* markings, but for these it is invaluable, as the following statement will demonstrate :—A valve of Triceratium was under exami-

nation by side light; its surface was seen covered with shallow craters, but when the lime light was shut off, and light thrown up from the mirror, the usual hexagons alone could be seen, and no contrivance would show the craters which were known to exist; yet, when the lime light was added, they were visible, but their situation was evidently nearer the eye than the hexagonal forms which lay within the surface, and could not be seen with the lime light alone. There was also a series of minute beads lining the inner surface of the hexagons, which could be seen only by transmitted light. Side light is, therefore, powerless for interior forms, though particularly useful for the exhibition of minute surface details. Each kind of illumination has, therefore, a value of its own, which in no way interferes with that of the other; still, it must be admitted, that no examination of these delicate objects can be considered complete till both methods have been employed.

I cannot conclude this paper without expressing the great satisfaction experienced in the use of the German powers by Gundlach; the distance at which they stand from the object when it is in focus, making them peculiarly valuable in this examination. I desire also to return my thanks to Mr. Curties, who kindly placed several high powers at my disposal.

EXPLANATION OF PLATE XVII.

Fig. 1 and 1*a*.	Portion of Isthmia nervosa.
Fig. 2.	Portion of Biddulphia.
Fig. 3.	Portion of Triceratium favus.
Fig. 4.	Portion of P. hippocampus.
Fig. 5.	Portion of Cocconema.
Fig. 6.	Edge of fragment of P. angulatum.
Fig. 7.	Theory of structure of valve.
Figs. 8 and 9.	Isthmia enervis.

[N.B.—The plate will be issued with the next number.]

South London Microscopical and Natural History Club.*

Inaugural Address. By R. Braithwaite, M.D., V.P.

(*Read May 16th*, 1871.)

In speaking of the objects to be carried out by associations like the present Society, it is scarcely necessary to dwell upon the advantages resulting from an acquaintance with science and natural history, for it must be profitable to everyone to know the structure and functions of the organic world around us, and especially in the young is it laudable to foster those habits of observation and orderly arrangement which will afterward be of service in every walk of life; be he a physician?—enlarging his powers of diagnosis; be he a clergyman?—supplying him with some of his most forcible arguments and impressive similes; or be he a workman?—then his work will be more artistic, his designs more chaste, the more clearly he understands those natural objects, from which in many instances his patterns are derived; or, lastly, to him who pursues the study for amusement, these observations will bring much to elevate and instruct, much that will make him a better and a wiser man; for this love of the true and the beautiful, as ceaselessly manifested in the phenomena of the organic creation, must react on every incident of daily life. And since we must presume that those who know most of God's works are indeed living nearer to Himself, then must this glorious instrument—the microscope—which places us at the gate of a new wonderland, be reckoned among the chief aids to moral improvement; on its use and manipulation I shall not speak, but leave that to such of my colleagues as are better qualified to do so.

In looking around for examples for our imitation, I would rather take you back a century, and place before you those naturalists, the immediate successors of Linnæus, to whom we owe so much, than involve you in theories of development or speculations on the origin of life; for to some here the plan of creation is doubtless still un-

* Printed by authority of the Committee of Q. M. C.

known. And what do we read in the record of their lives? They were almost, without exception, kind and simple hearted, and possessed of all those qualities that endear men to each other. The old butterfly hunter, no longer able to wield his net, sits by the hour on the woodside stile, and feasts his eyes with the mazy dance of the white admiral and others of his favourites.

The plant collector, with each returning spring, felt young again, and sallied forth with quickened pulse to see which of his old favourites was the first to greet him, ready to sing with Hurdis—

> "O, Proserpine, for the flowers now
> Which, frighted, thou let'st from fall Dis's waggon—
> Anemones that come before the swallow dares,
> And take the winds of March with beauty; pale Primroses
> And Violets dim, but sweeter far, than the lids of Juno's eyes,
> Or Cytherea's breath, bold Oxlips, and the Crown Imperial,
> With Daffodils, and Lilies of all kinds
> To make ye garlands of."

And the anemones, and the violets, and hundreds more still keep blooming on, each in its appointed season, and the butterflies flutter over them as they did a century ago; and shall we pass all by like—

> —"The sluggish clod, which the rude swain
> Turns with his share and treads upon?"

I trust not, especially when we have those aids to investigation unknown to the earlier naturalists. And this leads me at once to what I should wish to see studied—the natural productions of the district, the vegetation of the soil, and the living things, particularly the insects, which are found there also, and I trust an herbarium and cabinet, in which these may be preserved, will at no distant date form an important feature in the objects of the Club.

Biology, or the study of living things, naturally divides itself into two sections—zoology and phytology, or the animal and vegetable kingdoms—and although in the simplest forms of each these approximate so closely that we know no single absolute character by which they can be separated, yet practically we find no difficulty in assigning even the lowest organisms to their proper position.

Motility was at one time believed to be indisputable evidence of animal life, yet Volvox and Pandorina, with the great group of Diatomaceæ, are now unhesitatingly referred to the vegetable

kingdom, though most of us can remember the time when they were universally regarded as animals. But if we compare the rolling motion of the Volvocinæ or the gliding of a Diatom with the ever-changing form and direction in the Amœba, it will be seen at a glance that the absence of volition in the one and its presence in the other, at once sets up a line of demarcation between even the motion of the lowest animals and lowest plants.

And further, we have the difference that plants consume inorganic matter, and are nourished from without, animals consume organic, and are nourished from within.

When we look more closely into the structure of organic beings the most striking feature presented to us is the common plan on which everything is constructed, yet each having its organs modified or adapted to the functions they have to perform. Taking the lowest forms of vegetable life, we find that they are nothing but a simple cell, yet this cell is capable of absorbing nutriment, of reproducing its kind, and is in all respects perfect, and at one period of its existence the massive oak, the towering palm, the lowly primrose were nothing more. So again with the animal cell. This may bound the whole existence of the individual, or it may become so altered by multiplication, by growth of tissues, and differentiation of parts, that even proud man is attained; for he, too, at one period of his existence, was nothing but a simple cell.

The next point we shall notice will be the subservience of all the functions of life to the final one of reproduction; throughout all organic creation we find that very early a sexual distinction is set up, and a sperm cell and germ cell under some form or other results, and these having fulfilled their office the individual disseminates its offspring, and then in countless instances ceases to exist, or it may live on for several repetitions of the process, but these, sooner or later, must terminate with the life of the parent.

We will now glance at the principal groups which may profitably be made the subject of observation. Commencing with the vegetable kingdom, we find the structural development of plants is most important, and the existence of the plant as an individual is constituted thereby. All the lowest plants consist of cells and repetitions of them, and by their modifications variations of structure are produced; as we progress to higher orders a differentiation of tissues takes place, and we have the pitted and spiral vessels, woody fibre, &c., added to the other elements.

Lowest of all plants we place the Algæ, or the weeds of the sea and fresh water—an immense class, embracing species most minute, and some enormous in size. The minute species are the *Diatoms*, which we place at the bottom of the scale, and these propagate by the detachment of a vegetative cell, the new part becoming like the parent. These plants are invested with flint, which is marked with lines so minute that their true nature is still a subject of dispute. Next to these come the *Desmids*, also minute, and, like the Diatoms, propagating by fission, but they are not invested with flint and in some the first appearance of a generative process takes place by what is termed conjugation; that is, the junction of two individuals by a transverse tube, and the passage of the contents of one to the other, a spore or seed being the result.

Above these we rank the *Confervaceæ*, those green slimy masses of threads we see in pools and on rocks; these also reproduce by conjugation, and the spore or seed is endowed with active motion by means of cilia. *Fucaceæ* include the higher sea weeds, the tangles and red weeds so common on our shores; and now we observe special male and female organs, antheridia containing spermatozoids, and archegonia containing a germ cell, which are enclosed in a hollow receptacle.

Next to these we place a small family—the *Characeæ*—found in ditches and pools, remarkable for showing rotation of the colouring matter inside the tubes of which they are composed.

Above the Algæ come *Fungi*, another great class, embracing many thousand species, not only the mushrooms, toadstools, and puffballs, but all the minute ones constituting mould, smut, and rust, which attack decaying vegetables, and also occur in the tissues of living plants.

These also generate by antheridia and archegonia, and in their minuter forms supply many elegant objects for the microscope.

Next come the *Lichens*, those grey patches that coat over the ruined tower, or storm-beat rock, or hang in shaggy tufts from aged trees; two forms of reproductive organs have been found, which are collected in cups or shields, and some 3,000 species are known. All these groups are without a distinct axis of growth, and have no leaves, and form a first great section—Thallogens.

An easy step leads us to the *Hepaticæ*, or Liverworts, moss-like plants, with lobed leaves, and spiral threads mixed with the seeds; and from them again to the *Mosses*, which have simple leaves and

spores free from threads ; and then to the *Ferns* and some small orders, all having antheridia, or male organs, and archegonia, or female, with a distinct elongated axis, and true leaves, and thus making a second great section—Acrogens ; the whole forming the great division of Cryptogamous plants, or those without evident flowers, but more particularly characterised by the fruit being sporiferous.

We then pass to the Phœnogamous, or flowering plants, in which male fertilizing grains or pollen are produced ; these falling on the stigma throw out a tube, which passes through its tissue and reaches the germinal vesicle of the ovule, and each ovule, being fecundated, becomes a perfect seed.

Now every part of every plant is worth investigation, and it is only by means of the microscope that we can obtain a true knowledge of their structure.

As interesting objects, I may refer to the pollen—the cuticle, or skin covering leaves, with its stomata or breathing pores—the woody tissue and fibro-vascular-bundles, and the various modifications in the form of hairs and seeds.

Passing next to the Animal Kingdom, we find the lowest animals, like the lowest plants, are of the simplest structure, and hence are named *Protozoa*, or first animals, the first group of which is termed *Rhizopoda ;* and, as a type of them, we may take Amœba, a little gelatinous speck often found gliding on aquatic plants, constantly changing its form by pushing out portions of the sarcode of which it consist. There is no mouth, and the food is simply pushed through its walls by their gelatinous material, as it were, flowing over it ; the internal organs are a solid nucleus, and contain contractile spaces, while they reproduce by budding. A few others are invested in a thin flexible shell, by which we pass to the *Foraminifera*, enclosed in a firmer shell, built up of chambers which communicate by small apertures, and filled with sarcode. The loose sand shaken out of sponges usually contains a variety of these elegant organisms, allied to which, and even surpassing them in beauty, are—

2. The *Polycystina*, more minute, but eminently beautiful, and dredged up from the ocean bed ; or found fossil, as in the Barbadoes deposit.

3. The *Sponges*, whose skeleton consists of a network of horny fibres, strengthened by flint spicules presenting an infinite variety of shapes, the whole being enveloped in gelatinous sarcode.

4. *Infusoria*, or animalcules, include a large group, comprising the most minute of living creatures, highly interesting to watch during life, but not capable of being preserved satisfactorily.

Following the Protozoa comes another great class—the *Cœlenterata*, or Radiata—comprising the Sea Anemones and Polyps, nearly all of which are marine; one, however, the Hydra, is often found on water weeds, and therefore likely to come before you ; it consists of a gelatinous body, with long tentacles encircling one end, which wave about in the water, and clasp its prey. The *Echinoderms*, or star fish and sea urchins are also all marine.

The third great division, *Annulosa*, embraces animals whose bodies are composed of rings, and bearing limbs in lateral pairs, though in some these are absent. Lowest of these, and passing, as it were, from the last group, are the *Entozoa*, or intestinal worms, which have of late acquired considerable importance from the number of human beings infested by them, and for our full knowledge of which we are entirely indebted to the microscope. Next come the *Annelida*, or red-blooded worms, which have their organs more developed, and in which we observe a differentiation of the segments into a dorsal and ventral arch, each supporting appendages. The Leech and Earthworm represent the lower forms of this group ; and in the higher we have the beautiful Serpulæ and other tube-dwelling species, remarkable for the elegance of their plumed tentacles.

The *Rotifera* include many beautiful microscopic animals, which were long united with the Infusoria, but stand far above them in organisation ; with some of them you, no doubt, are familiar, as captives in the dipping bottles so assiduously plunged into every promising pool. Yet notwithstanding what Mr. Gosse has done to elucidate their structure, much has still to be learned repecting their life history.

The *Crustacea*, well known to you by the crab, lobster, and shrimp, also comprise many elegant minute species, which abound in pools, and belong to the order Entomostraca—such as Daphnia, Cyclops, Cypris, &c.—supplying interesting subjects for microscopic investigation.

Following these come the *Arachnida*, or spiders and mites, forming the orders Araneida and Acarida, readily known by the 1st and 2nd divisions, or head and thorax, being united in one piece, and by possessing four pairs of legs. Both groups are especially worthy of investigation : the spiders, for the wonderful diversity

existing in the palpi or feelers of the males; the mites, from the great variety in their forms, and the want of any English work describing them. Next to these comes the small group of *Myriapods*, or centipedes and pencil-tails; and then we arrive at the great class *Insecta*, the study of which, or entomology, has now become so ardently pursued that it is broken up into sections, and the moth hunter, or Lepidopterist, will have nothing to do with the Beetle man, or Coleopterist, nor the Fly man with either.

As objects of interest even to the young, few things surpass a well-mounted collection of insects, and I do look forward to the time when the insect fauna of the district shall be represented in the Cabinet of the Club by actual named specimens; while to the possessor of a microscope they yield an endless supply of objects, all showing the most wonderful adaptation in each organ to the purpose it is designed to accomplish, whether it be the trophi or feeding organs, or those of flight, respiration, or reproduction.

The last great division of the invertebrate animals is the *Mollusca*, comprising slugs and shell-fish, of which time does not permit me to speak, except to suggest that the shells of the land and fresh water molluscs of the district should also be collected.

I may fill up our scale by inserting at least the names of the classes composing the *Vertebrata*. These are: *Fishes*—*Amphibia* or Frogs, Toads and Salamanders. *Reptiles* or Snakes, Lizards and Tortoises. *Birds*. *Mammalia*. And by these we reach the prince and head of all creation—man. And what does the microscope teach us with regard to ourselves? Not that we stand apart from the rest of the organic world, but that every organ and tissue has its counterpart in structure and function among creatures far below us, and that of the many thousands of living beings each forms a link in the vast chain by which even man and the Amœba form one harmonious whole. To man, however, is given something more —knowledge, reason, and responsibility; and by these we are led far beyond the limits of the small circle that bounds our daily life, still to find ever outreaching the farthest grasp of microscope or telescope, yet present every moment to our unaided vision, one Creator and Preserver of all, through whom we and all things live and move and have our being.

PROCEEDINGS.

June 9th, 1871.—Conversational Meeting.

June 23rd, 1871—*Chairman*, Dr. R. Braithwaite, F.L.S., Vice-President.

The following donations to the Club were announced :—

"Land and Water," (weekly)	from the Editor.
"Science Gossip"	the Publisher.
"Journal of the London Institution"	the Librarian.
"The American Naturalist"	in exchange.
"Observations and Experiments with the Microscope on the Chemical Effects of Chloral Hydrate, Chloroform, &c., on the Blood."...	from the Author, Mr. T. S. Ralph.
Manual of Zoology	Mr. J. W. Groves.
6 Slides	Mr. T. Curties.
3 Slides	Mr. Hennah, Brighton.
6 Slides—Sections of Echinus Spines	Mr. F. Marshall.
2 Slides—Pro-legs of Crab	Dr. Lowe, King's Lynn

The thanks of the Club were voted to the donors.

The following gentlemen were balloted for, and duly elected members of the Club :—Mr. William P. Bartlett, Mr. Cedric Bucknall, Mr. Thomas D'Aubney, Mr. Henry E. Freeman, Mr. Edward Harris, Mr. Thomas Isaac, and Mr. Amos Topping.

Mr. N. E. Green read a paper "On Diatom Markings as seen by the Oxy-calcium Light."

The Chairman, in proposing a vote of thanks to Mr. Green, observed that all present would, doubtless, agree with him that no apology was necessary from the author for the fragmentary nature of his communication. The paper was, indeed, just of that practical kind which was wanted at the meetings. A vote of thanks was then carried unanimously.

Mr. B. T. Lowne said that although he had not worked at Diatomaceæ, and knew little more about them than had come under his notice as a student of Natural History generally, he could not help saying that Mr. Green's remarks commended themselves to him as by far the most likely explanation of the markings of diatoms that he had ever heard. The description Mr. Green had given appeared to him to be in consonance with the structure of such parts as

the shells of Molluscs; Mr. Rainey had long ago pointed out that mineral substances, such as carbonate of lime, when crystallising in a colloid fluid, were very prone to form spheres and dumb-bell crystals. According to Mr. Green's description the shield of a diatom seemed to consist of an aggregation of similar pellets of silex, the convex markings, or beads, being the surfaces of crystalline pellets, and the spheres being modified into hexagonal prisms by mutual contact with a segment of a sphere at their free surface. It would be seen at once that this theory would not account for the crater-like pits on the surface; but the appearance of these depressions brought to his (Mr. Lowne's) mind the almost irresistible idea that they resnlted from disintegration and solution of the surface of some of the flinty pellets: they are undoubted erosions with ragged edges. Of course he only suggested this view as a pure hypothesis, but it did seem to him probable that if absorption or solution of the flint laid down were going on simultaneously with deposition at certain points, it would account for the appearance.

Mr. T. C. White said that however much he might admire it he felt he must demur to some portions of the beautiful theory which Mr. Lowne had built up. One fatal objection to the idea of the diatomaceæ being formed by crystallization, as in Mr. Rainey's experiments, appeared to be the perfect regularity of their surfaces; such crystals formed in merely a colloid substance would be irregular in size, instead of being so perfectly regular, as were the diatom markings.

Mr Lowne, in reply, said that with regard to Mr. White's objection, he believed it to be merely founded on a misapprehension of the conditions under which these crystals would be formed. He believed that under such a medium as he had supposed, the silica would be deposited with regularity, because the laws under which its deposition took place were the same all over the shield, and there appeared to be no reason why one pellet should be larger than another. Nobody would, of course, attempt to maintain that the silica was alive. What they had there was a simple mechanical support or skeleton, the structure of which still appeared to him to bear a strong analogy to the deposition of carbonate of lime from a colloid solution, such as is seen in the shells of the mollusca. He believed the subject might be easily worked out by observing the development of the shields of some of the larger diatomaceæ.

Mr. Ingpen hoped that the ingenious speculations which had been advanced would not lead members away from the subject of the paper, which was a really practical one. He should himself like to ask for some more information as to the *modus operandi*, and would be glad to hear whether the light was thrown upon the object parallel,— whether it comes through slits, or what was the process? He thought they ought not to let this paper sleep without some further investigation.

Mr. Breese thought that the view taken by Mr. Lowne was open to some negative evidence, and suggested a mode of examining diatoms, which, he believed, would be found very useful. His plan was to obtain an ordinary slide 3 × 1in., and to wrap round it a quantity of fibrous glass, such as that of which the glass peacocks' tails were made, and then, having floated upon it some of the diatoms, cut the glass fibres, and they would have the diatoms propped up upon the fibres in such a manner as to enable them to be examined with great advantage; a very brief examination would show that it was bad to view them through covering glass, or any other medium. The result of his observations was that he could most fully bear out the remarks of Mr. Green. Viewed in the manner he had described, they conveyed to his mind the idea of the shape of

corrugated iron, having the round form on one side and the hollow on the other alternately. He had examined them with an $\frac{1}{8}$in. objective, and thought that many gentlemen would find the method he had mentioned to be very advantageous.

Mr. Green, in reply, said that with regard to the method of using the lime light, it was very simple—he had it mounted on a little stand, so as to bring it as nearly parallel as possible ; if the light were brought a little nearer to the observer than the distance of the stage, it would be an advantage, because the glare from the illuminated surface of the diatom was so great that it teazed and bothered the eye sadly,—the glare, however, might be in some degree checked by putting a stop in the eye-piece. The light was easily produced and managed ; they must get some oxygen made, and put into a gas bag, and could use with it some of the ordinary hydrogen from any burner ; the ball of lime should be placed about 6 inches from the stage, and, immediately before the object, a small plano-convex lens should be fixed so as to converge the beam of light upon the object. He should judge, from his own experience, that an uncleaned and unbleached specimen was the best for examination, as it would be found free from that intense glare produced by reflection from the white surface which resulted from boiling in acid. He might add that he found the German $\frac{1}{12}$in. objective of great value, as it allowed him to get a great increase in the angle at which he could use the light ; he found it to be, in magnifying power, exactly double that of one of Ross's $\frac{1}{6}$in., whilst it possessed the very great advantage of standing nearly trebly distant from the object when in focus.

The Chairman said that, to his mind, there was something in the theory which did not seem quite satisfactory ; he did not, for instance, think that the comparison between the formation of a vegetable cell and that of the shell of a mollusc could be very clearly borne out; but the subject was, no doubt, a matter of great difficulty.

The Chairman then notified to the members present that, in accordance with the bye-laws of the Club, they had that evening to nominate gentlemen to fill the offices of Vice-Presidents for the ensuing year, and also other gentlemen to fill vacancies upon the committee ; the elections of four Vice-Presidents and four members of the committee would be proceeded with by ballot at the Annual General Meeting in July. He then read the bye-laws 2 and 3, and invited nominations accordingly.

The following gentlemen were then nominated as Vice-Presidents :—

Dr. Braithwaite,	proposed by	Mr. N. Burgess,	seconded by	Mr. W. Hainworth, jun.
Mr. A. E. Durham	,,	Mr. Suffolk	,,	Mr. McIntire.
Dr. W. J. Gray	,,	Mr. Hailes	,,	Mr. Oxley.
Mr. C. J. Leaf	,,	Mr. M. C. Cooke	,,	Mr. T. Crook.
Mr. Henry Lee	,,	Mr. G. D. Brown	,,	Mr. Golding.
Mr. R. T. Lewis	,,	Mr. W. Hainworth, jun.		Mr. T. Curties.

The following nominations for members of committee were also made :—

Mr. W. H. Golding,	proposed by	Mr. T. Curties,	seconded by	Mr. Ingpen.
Mr. Greenish	,,	Mr. T. C. White	,,	Mr. Lowne.
Mr. Loy	,,	Mr. McIntire	,,	Mr. Gay.
Mr. Marks	,,	Mr. Breeze	,,	Mr. Hailes.
Mr. Oxley	,,	Mr. Crook	,,	Mr. Jacques.

The President intimated that the next business before the meeting was to appoint two gentlemen to audit the accounts of the Club for the past year; one

of these gentlemen to be named by the members, and the other by the committee.

On behalf of the members, Mr. Marks was proposed as auditor by Mr. Hailes, seconded by Mr. Golding, and elected unanimously; and the Chairman named Mr. Suffolk to act as auditor on behalf of the committee.

Mr. Suffolk said that he wished to make a few remarks with reference to two slides, which contained objects injected with chromate of lead, or chrome yellow. The objects appeared, upon examination, to be mounted in tin cells, which he had himself introduced some time ago, and the colour of the pigment had entirely disappeared, and the metallic lead was deposited in the substance of the object. He had named it to Mr. Crookes, who was of opinion that an electro metallic action had been set up by the tin cell, and that this had reduced the lead. He thought that the Club should be made aware of this, although he believed it to be a mere accident. He did not know whether any members had met with similar accidents from mounting in tin cells; but he thought the circumstance should be made known.

The proceedings then terminated with a *conversazione*, at which the following objects were exhibited :—

Gold in Quartz...	by Mr. Golding.
Melicerta Ringens	Mr. W. Hainworth, jun.
Shrimps recently Hatched	Mr. Martinelli.
Plumatella Repens	Mr. Oxley.

July 13th, 1871.—Conversational Meeting.

The following objects were exhibited :—

Cystine (polariscope)	Dr. Matthews.
Argulus foliaceus	Mr. Geo. Williams.
Hydra vulgaris	Dr. Ramsbotham.
Convallaria	Dr. Ramsbotham.
Rotation in Vallisneria ($\frac{1}{4}$in.)	Mr. Nelson.

ANNUAL MEETING,

July 28th, 1871.—*Chairman*, Dr. Lionel S. Beale, F.R.S., &c., President.

The minutes of the preceding meeting having been read and confirmed,

The Secretary read the Annual Report of the Committee, and the Treasurer's Annual Statement of Accounts.

The President congratulated the members upon the highly satisfactory state of the Club, as set forth in the report which had been read, and moved that it be received and adopted.—Carried unanimously.

The President read his annual address to the Club, which was listened to with great attention and warmly applauded.

Dr. Gray felt sure that all would agree with him in proposing a vote of thanks to the President for his able and interesting address.

Dr. Matthews had very much pleasure in seconding the proposal, which was then put to the meeting and unanimously carried.

The President having briefly responded,

The ballot for officers for the ensuing year, in place of those retiring in accordance with the bye laws, took place, Mr. Ward having been appointed scrutineer on behalf of the Committee, and Mr. W. W. Reeves on that of the members.

The Scrutineers having handed in their report, the following gentlemen were declared to have been duly elected—

As President ...	Dr. Lionel S. Beale, F.R.S.
As Vice-Presidents ...	Dr. R. Braithwaite. Mr. A. E. Durham. Mr. Chas. J. Leaf. Mr. Henry Lee.
As Four Members of Committee ...	Mr. W. H. Golding. Mr. T. Greenish. Mr. W. T. Loy. Mr. E. Marks.
As Treasurer ...	Mr. R. Hardwicke.
As Hon. Secretary ...	Mr. T. C. White.
As Hon. Secretary for Foreign Correspondence.	Mr. M. C. Cooke.

A vote of thanks to the Scrutineers was proposed by the President, seconded by the Secretary, and carried unanimously.

The President expressed a hope that Mr. R. T. Lewis would continue to carry on the work which he had so long performed, by acting as reporter to the Club during another year.

The Secretary joined in making a request to Mr. Lewis for a continuance of his services, and bore testimony to their value in the past.

The following donations to the Club were announced:—

"Land and Water" (weekly)	from the Editor.
"Science Gossip," for July and August ...	the Publisher.
"The Popular Science Review"	,,
"The Monthly Microscopical Journal for July and August	,,
"The American Naturalist"	in exchange.
"Proceedings of the Geologists' Association"	the Secretary.
"Smithsonian Annual Reports for 1868-9"...	the Secretary of the Smithsonian Institution, Washington.
1 Slide	Mr. L. Bennett.
2 Slides	Mr. N. Burgess.
50 Slides of Diatomaceæ, from the Collections of the late Professors Gregory, Greville, and Arnott, from different friends of Mr. Thomas Curties	Mr. T. Curties.
58 Slides	Mr. G. Paton.
24 Slides (general specimens)	Mr. Amos Topping.
6 Slides	Mr. J. G. Waller.
24 Slides	Mr. T. C. White.

The thanks of the Club were unanimously voted to the donors.

The following gentlemen were balloted for and unanimously elected members of the Club: Mr. William Bishop, Mr. Frederick C. Clark, Mr. G. C. Drew, Mr. John R. Furneaux, Dr. Arthur E. Sansom, Mr. Robert P. Williams.

Mr. Blankley introduced a new reflecting chimney for microscope lamps, in which a coating of electro silver was deposited upon the outside of the glass, and he had, at the suggestion of Mr. Swift, coated this with copper to preserve it, and found it to answer admirably. He also exhibited and described a small universal revolving stage, into which various pieces of apparatus could be fitted.

The President inquired who got the chimneys done, and who supplied them?

Mr. Blankley said Mr. Swift, of 43, University Street, supplied them. He hoped to be able to bring them out at 1s. each, but at present he found that they cost rather more.

Mr. T. C. White asked if they were liable to crack with the heat of the lamp?

Mr. Blankley said that he had put the chimney which he exhibited to the test, and found that it did not crack, and was in every respect most satisfactory.

The Secretary read a letter which he had received from Mr. Furlonge, pointing out that the immersion paraboloid described in the July number of the Journal was really the invention of Dr. Barker, of Dublin, although no mention had been made of his name in connection with it. He (the Secretary) regretted that neither Messrs. Ackland nor Suffolk were present, as he felt sure that they would very readily explain the matter.

Mr. Reeves said that the omission of Dr. Barker's name was evidently quite a mistake, as the gentlemen in question were well aware of the facts, indeed he had himself showed Mr. Suffolk the article describing the paraboloid in the "Transactions of the Royal Dublin Society."

Mr. T. Curties stated that as a friend of Mr. Furlonge he particularly noticed at the time that Dr. Barker's name *was* mentioned, although it did not appear in the Journal; had it not been mentioned he should certainly have called attention to it himself.

The President was glad to have the matter so satisfactorily explained, and said it could now be set right in the next number of the Journal.

The proceedings then terminated with a *conversazione*, at which the following objects were exhibited :—

Scalariform Tissue of Pteris Aquilina ...	by Mr. N. Burgess.
Artemis Salina (alive)	Mr. Burr and Mr. J. Williams.
Palate of Cuttle Fish	Mr. McIntire.
Antenna of Cockroach	Mr. Richardson.
Water Devil, Water Flea, &c....	Mr. Geo. Williams.
Artemis Salina (mounted)	Mr. R. P. Williams.

August 11th, 1871.—Conversational Meeting.

AUGUST 25TH, 1871—*Chairman*, DR. R. BRAITHWAITE, F.L.S., &c., Vice-President.

The following donations to the Club were announced :—

"Land and Water" (weekly)...	from the Editor.
"The American Naturalist"	in exchange.
The Archives of Science, of Orleans County ...	in exchange, J.C.W.
Report on Photographing the soft tissues by sunlight, &c., by Assistant-Surgeon Woodward, United States Army, accompanied by 10 Photographs in illustration	from the Surgeon-General—Army Medical Dept., Washington.

The thanks of the Club were unanimously voted to the donors.

The following gentlemen were balloted for and duly elected members of the Club :—Mr. Ralph W. Leftwich, Count Joseph Taverna, of Milan.

Mr. M. C. Cooke introduced to the meeting Mr. James Ward, of New York, one of the Founders of the Bailey Microscopical Club of that City.

Mr. Cooke then—having referred to some doubts expressed by a gentleman at the previous meeting of the Club as to whether diatomaceæ were of vegetable origin, and expressed his willingness to meet that gentleman in argument upon the question—proceeded to lay before the meeting some interesting facts relative to the nuclei in certain fern spores, and their unaccountable disappearance after they had been for some time mounted as microscopical objects.

The President was sure that all members present would feel with himself, highly indebted to Mr. Cooke for his very interesting communication, although he thought that if Mr. Cooke—who had made fungi a life study—could not explain the reason why these nuclei disappeared, it was hardly likely that any of his audience would be able to do so. He would, however, suggest that possibly it might be a process of growth going on ; the parts being surrounded by a moist medium, might continue to grow, even though separated from the original mass ; this, however, was merely a suggestion. Before resuming his seat, he desired to call the attention of members to that Multum in Parvo of Mr. Cooke's, his "Handbook of British Fungi," two copies of which had that evening been added to the library of the Club.

Mr. Cooke explained that the spores were found to have nuclei in the ripe, and even in the state approaching to putrefaction ; they were, in fact, never found to be absent at any period of growth.

Mr. James Smith observed that in speaking of the spores, Mr. Cooke said they were mounted in glycerine, and it occurred to him that there was a possibility of the glycerine getting in, and so rendering them invisible. He also noted in Mr. Cooke's remarks what seemed to him a very excellent plan for preserving the slides; after doing them over with gum dammar, &c., he covered them over with paper, and this seemed to him to add very greatly indeed to the chances of their preservation.

The Chairman thought that if the nuclei were always present, glycerine could hardly obscure them.

Mr. Cooke said he would try to find some of the specimens he had alluded to, and would bring them for members to judge from their own observations.

The Secretary begged to thank Mr. Cooke very warmly for what he had done by bringing forward so interesting a subject ; he was asked to give them a paper, but he had really given them something much better.

Mr. S. J. McIntire said that he had brought with him to the meeting some

Photographs, intending to make a few remarks upon them, but he was not aware at the time that Dr. Woodward was going to present copies also to the Club. These photographs were taken by Dr. Woodward's new process, and were very interesting proofs of his success. Some time ago, from difficulties which he met with, he had given up the use of sunlight, and had made use of the electric light and magnesium instead ; but he had lately been trying sunlight again, and had at length overcome all his difficulties. When Mr. Beck was in America, he gave to Dr. Woodward a Podura scale, which he said was the finest he had ever seen, and of this Dr. Woodward had taken two photographs, one of which was perfectly in focus, and the other, by a slight alteration, showed to some extent the beaded structure described by Dr. Pigott, and about which there had lately been so much controversy. He held himself that these beads were illusions, but that the exclamation marks were not. Dr. Maddox thought that the whole of the appearances, including the exclamation markings, were optical illusions, and Mr. Wenham called the exclamation marks disjointed ribs, to which term he objected, because it supposed the existence of joints. There was another scale of great interest to persons who took up the subject, that of the speckled podura. By the use of a little apparatus of Mr. Wenham's invention, consisting of a little truncated lens placed below the slide, when properly adjusted, a very beautiful dark ground illumination is obtained, and the scale is seen to shine in a black field with remarkable clearness. Dr. Woodward had photographed the podura scales shown in this manner, and these might be considered, perhaps, the most wonderful pictures he had ever taken, because of the great difficulty which attended it. He hoped to be able to bring his microscope and show the scales in this manner; the effect was very striking, the exclamation markings seeming quite to stand up. He believed fully that the beads about which so much had been said, were only illusions and ghosts.

The Chairman, in thanking Mr. McIntire for his communication, observed that no one had worked more at the subject, and that due weight would, no doubt, be given to his opinions.

Mr. Richards exhibited to the meeting a new rackwork erector, which he described as being a considerable improvement upon those commonly in use. Nothing particularly new was found in the results produced, but his arrangement was a different and improved method of obtaining those results.

The Secretary read a letter from Mr. Jackson, relative to the omission of Dr Barker's name in connection with the immersion paraboloid, to which subject reference had been made at the preceding meeting.

The usual conversazione concluded the proceedings, at which the following objects were exhibited :—

Trachea of the Larva of Dytiscus	by Mr. Hainworth.
Mermis Nigrescens	Mr. R. T. Lewis.
Artemis Salina—in early stage and in maturity	Mr. R. P. Williams.
Argulus foliaceus, alive .. ... Daphnia Pulex, alive	Mr. Geo. Williams.

On Nucleated Sporidia.

By M. C. Cooke, M.A.

(*Read August 25th,* 1871.)

The section of British Fungi to which I desire to draw more particular attention is that group of Helvellacei, which are associated together under the generic name of *Peziza.* This genus is represented in our islands by between 150 and 200 species, all of which are characterised by their cup-like form, and more or less fleshy substance. They range in size from a point just, distinguishable by the naked eye, to at least four or five inches in diameter. In colour there is a great variety,—some having bright carmine, vermilion, or cœrulean tints, and others of more modest browns, greys, or snowy-white. In many instances the outside of the cup is granular, hairy or woolly; whilst in others it is perfectly smooth. All these features are taken into account in the determination of species. The structure of these fungi are the points of greatest interest to the microscopist, and can best be studied in some such large species as *Peziza aurantia,* or *Peziza vesiculosa,* neither of which are uncommon. If we take one of these cup-shaped fungi when mature, in its fresh state, and cut it down through the centre, we shall observe first that the outside and inside of the cup varies somewhat in texture, as well as in colour. That the inside has usually a smooth, delicate, waxy appearance, and, if exposed to the light for a few minutes, little smokey puffs of the minute spores will from time to time be ejected from the surface, as of miniature discharges of fairy artillery. By cutting a thin slice from the cut surface of the section and placing it under the microscope, a good notion of its general structure will be obtained. The slice should be as thin as a sharp knife and a steady hand can accomplish. If this slice be placed in a drop of water, or pure glycerine, on a slide, and covered with thin glass, then submitted to a slight pressure, it may be examined freely with a quarter inch objective. Towards the

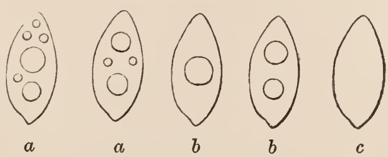
inner surface, which is the *hymenium*, numerous transparent tubes, or cylindrical sacs, present their upper extremities, whilst their lower ends coalesce with the cellular substance of the cup. These cylindrical bodies are the *thecæ* or *asci*, mixed with thread-like filaments called *paraphyses*. Sometimes the paraphyses are simple, at others branched, and either attenuated or clavate at their tips. In a few cases the club-like extremities of the paraphyses are coloured, but usually the asci and their contents, as well as the paraphyses, are colourless. In this genus the paraphyses are important features in the determination of species, since they offer considerable variation in different species. What may be their special function has not been satisfactorily determined. Some authors have suggested that they may be barren asci; but this suggestion is far from confirmation by fact, no observations having yet traced the development of paraphyses into asci, or explained why they are so distinct from asci even in the earliest stages at which they can be traced. Similar bodies are also present in the cups of lichens. The asci in their earliest stages are filled with a granular matter, which ultimately is collected (normally) into eight spherical, elliptical, or elongated sporidia, which fill the ascus, and when mature are discharged by rupture at the apex, in little puffy clouds of sporidia, as already intimated.

It was for some time a matter of concern with me how to mount and preserve these delicate sections of *Peziza*, so that they should retain their form unchanged for examination and comparison throughout any period of time. The watery character of these fleshy fungi is one great obstacle to the employment of balsam as a medium, and specimens so mounted are mere caricatures of their originals. Many difficulties beset objects mounted in fluid, and glycerine has not been a great favourite for such a purpose. Latterly, however, I have found nothing better than pure glycerine employed in the following manner. The fragment of *Peziza* is placed on a slide in a drop of glycerine (diluted glycerine is a mistake, the purer the glycerine the better), then cover with thin glass, three-quarter inch square, press firmly and hold it in position with a wire clip. Blotting paper removes all extraneous glycerine which is pressed out from beneath the cover, or if not quite clean, a camel hair pencil and water will complete the cleansing. In the next stage of the process the edge of the cover is painted round with gum dammar dissolved in benzole. This solution is more inde-

pendent of glycerine than any other, the benzole and glycerine being on good terms with each other. When this luting is dry, which is accomplished in two or three days, the wire clip may be removed. It is advisable now to wash the surface of the slide carefully, by means of a soft camel-hair pencil and water, so that all traces of glycerine may be removed, taking care not to disturb the luting of dammar. When thoroughly dried, after this washing, some tenacious cement should be coated over the dammar, such, for instance, as old gold-size. This adds to the security of the mounting. When the cement is hard, in order to provide still more for the permanency of the slide, I cover it with paper in the ordinary manner, and label the object fully.

By the means now described, I have succeeded in making good slides of sections of *Peziza*, Truffles, and other fleshy fungi, scarcely distinguishable from fresh sections, and these remain unaltered for many months, except in such cases as I have presently to allude to. Hence I am led to hope that such slides are moderately permanent, whilst, at the same time, more natural than any hitherto mounted by any other plan. The section required for this purpose is so thin, that the quantity of glycerine is very small, and there is so little depth in the mount that an eighth of an inch objective may be employed with advantage.

Those who have viewed the sporidia of *Peziza*, especially of such a species as *P. lanuginosa*, will have noted that the presence of "nuclei," as they are termed, is so universal in certain species, and apparently so permanent, that they have been introduced into the diagnoses of species. In the case of *P. lanuginosa*, the sporidia are large, and with two or more nuclei (*a a*). As far as I have observed this species, the nuclei are present in all stages of growth. Specimens were mounted in glycerine last year by the method I have described, and when mounted, all the sporidia had nuclei, some with one or two large, and two or three smaller nuclei, but all were nucleate. Examining the specimen again in a few weeks, I found that all the smaller nuclei had disappeared, and only large nuclei could be seen, whilst some sporidia were without nuclei (*b b*).



Sporidia of *Peziza lanuginosa*.

During the past week I have examined the slides again, but amongst all the sporidia, whether free or still enclosed in their asci, not a single sporidium can be detected in which a nucleus is visible (*c*). Here then is a problem which requires to be solved. What are these nuclei, and how does glycerine affect them that they disappear? It has been said that they are bubbles of air, to which I cannot at present accede. It has been assumed also that they are of an oleaginous nature, which is more probable. Whatever they may be, does the infiltration of glycerine through the the walls of the sporidia cause absorption of the nuclei, and the reduction of the cell contents to a homogeneous fluid? Would any other fluid, such as spirit or distilled water, produce the same results? This I have not at present endeavoured to ascertain, but of one thing I do feel certain that the presence or absence of nuclei in the sporidia of fungi, such as *Pezizæ*, and probably also of *Sphæriæ* should not be relied upon too much. It is evident that they are by no means permanent. This we know to be the case with many species of *Sphæria*. At an early stage the sporidium will contain two nuclei, later the sporidium is pseudo-septate from division of the endochrome; later still, it appears to be decidedly septate. These are changes which may be observed in the contents of a single perithecium. Even later still, the sporidia may acquire a deeply coloured epispore; but all these changes have not been observed in *Peziza*. In this latter genus the sporidia are rarely septate, and in *Peziza lanuginosa*, for instance, although the nuclei are so large and so distinct, a septate sporidium has never been seen. I have long been of opinion that nucleate sporidia in *Sphæria* are never permanent, but ultimately become resolved into as many cells, and that the sporidium which at first is binucleate, or quadrinucleate, at length becomes uniseptate, or triseptate. In *Peziza lanuginosa* it does not seem to be a question of age, nor in *Peziza* generally, hence I have been induced to ventilate the subject in order that more observers may enter upon the examination, and endeavour to arrive at some satisfactory conclusion.

Notes on Podisoma.

By M. C. Cooke, M.A.

(*Read November 24th*, 1871.)

Since it is evident that some considerable time must elapse before it is possible to publish an "Introduction" to the "Handbook of British Fungi," it has been suggested that from time to time some contributions to this work should be submitted to the Club, especially on species which require the microscope for their discrimination.

It will be remembered by those who have paid any attention to the growth of junipers, that these plants are very subject to peculiar parasites, which cause the branches to swell to twice their original diameter, through a length of from one or two, to three or four inches. These gouty swellings in the spring and summer, are from year to year perforated by yellow or orange gelatinous masses, usually of a more or less clavate form, from a quarter of an inch to an inch in length. These tremelloid masses externally and superficially bear considerable resemblance to some species of *Tremella*, but the uniseptate spores (as they have been called) show a manifest affinity with the brands, or genus *Puccinia*, of Coniomycetous fungi, and are now grouped with them under the two genera *Podisoma** and *Gymnosporangium*. These are therefore somewhat aberrant genera of the order *Pucciniæi*.

Many mycologists have placed these fungi with *Tremella*, on account of their tremelloid consistence. Of these may be mentioned Wulfen,† Bulliard,‡ Persoon,§ Hoffman,‖ and in our own country Dickson and Withering. The most recent instance of this mis-

* Cooke's Handbook of British Fungi, pp. 509.
† Wulfen in Jacquin's Collectanea, ii., p. 173, 174.
‡ Bulliard, Champignons, p. 223, pl. 427.
§ Persoon, Dispositionis Methodicæ Fungorum, p. 38.
‖ Hoffman, Vegetabilia Cryptogama, i., p. 33.

taken notion of the affinities of this little group occurs in the Handbook published by Bonorden in 1851.*

In this work *Podisoma* (including *Gymnosporangium*) is classed with *Dacrymyces* and *Coryne* in the first family of the order *Tremellini.* The older botanists took their characters from external appearances, but Bonorden had access to microscopes, such as were unknown at the time of Bulliard, Persoon, Dickson, and Withering, and the grouping of these fungi as he has done cannot be excused on the ground of ignorance of structure, but of a misconception of their affinities.

Tulasne showed, in his communication to the Academy of Sciences,† that the affinities of the special vegetation of the bilocular spores of *Podisoma* were with those of *Æcidium*, *Uredo*, *Puccinia*, and *Phragmidium.* In a note to his memoir on the Tremellini, he has also expressed a most decided conviction that such are the affinities of this small group. It is to this memoir‡ that we are greatly indebted for the details of germination in *Podisoma.*

If we take a portion of the orange substance which constitutes the fungoid parasite of the common juniper, during the spring, and place it in a drop of water under the microscope, we shall observe that it consists of a multitude of brown bilocular spores, or spore-like bodies, with very long transparent peduncles. These spores, for so they were long regarded, bear a striking resemblance to those of some species of *Puccinia*, with this difference. that they are imbedded in gelatine, whereas in *Puccinia* the clusters of spores burst through the cuticle of the plant on which they grow, free of each other, or when more compact than usual, not held together by a gelatinous medium.

In 1848 M. Gasparrini § showed that the bilocular spores in *Podisoma fuscum* did not deserve the unqualified designation of spores, although they certainly germinated; but he held that the spores of the fungus owed their origin to a special condensation of the plastic matter contained in the germ filaments (budelli) emitted by the so-called spores. This announcement was by no means favourably received by mycologists at the time

* Bonorden, Handbuch der Allgemeinen Mykologie, pp. 148.

† Comptes Rendus, 20 June, 1853.

‡ Tulasne, Annales des Sciences Naturelles, 3rd Ser., Vol. xix. (1853), pp. 193-226.

§ Gasparrini in Rendiconto dellæ reale Accad. dellæ Sci. di Napoli. No. 41, Sept. Oct. 1848.

although the main facts have since been established by Tulasne by examination of *Podisoma Juniperi-communis*, Fries. "I was able," he says, "to determine that the bipartite sporidia attributed to *Podisoma* were not, notwithstanding their spore-like form, and their kind of germination, really analogous to the ordinary spores of fungi, and that it would perhaps be more exact to compare them with the quadrilocular basidia of the *Tremellæ*. These pretended spores are formed of two large conical cells, opposed by their base and easily separating, they vary in length between ·06 and ·08 of a millemetre, and measure 015-·019 m.m. in their greatest transverse diameter. The membrane of which they are formed is thin and completely colourless in most of them, though much thicker, and coloured brown in others.* It is principally the spores with thin membranes that emit from near the middle very obtuse tubes, having a diameter of from ·007 to ·01 of a millimetre, and into which by degrees as they elongate the contents of the parent utricles pass. Each of the two cells of the supposed spore may originate near its base four of these tubes, opposed to each other at their point of origin, and their subsequent direction; but it is rather rare for eight tubes (two by two) to decussate from the same spore, or basidium. Usually there are only two or three which are completely developed, and these tend together towards the surface of the fungus, which they pass, and expand at liberty in the air. The tubes generally become thicker by degrees as they elongate, some only slightly exceeding the length of the basidia (protospores); others attain three or four times that length, according to the greater or less distance between the basidium† (protospore), and the surface of the plant. In the longest tubes it is easy to observe how the colouring matter (endochrome) passes to their outer extremity, leaving the portion nearest to the parent cell colourless and lifeless. When nearly attaining their ultimate dimensions all the tubes are divided towards their outer extremity by transverse septa into unequal cells; then simple and solitary processes of variable length and form, but attenuated upwards, proceed from each segment of the initial tube, and produce at their extremity an oval spore (teleutospore) which is slightly curved and unilocular. These spores absorb all the

* This seems to be dependent on the degree of maturity at which they may have arrived.

† This is the term employed by Tulasne for the primary spores, but we prefer calling them "protospores."

orange endochrome from the original tubes, and measure from ·01 to ·013 of a millemetre in length. They appear in immense numbers on the surface of the fungus, and when detached from their spicules fall upon the ground, or on any object which may be beneath them, in the same manner as the spores of an Agaric are dispersed. So freely are they deposited that they may be collected on paper or a slip of glass like a fine gold-coloured powder. "These bodies evidently represent," says M. Tulasne, "the last stage, and normal aim of the vegetation of the pretended bilocular sporidia (protospores) of the *Podisoma*, and alone justly deserve the name of spores."

Again, these secondary spores (teleutospores) regarded by Tulasne as the true spores, are capable of germination, and many of them will be found to have germinated on the surface of the *Podisoma*, whence they have originated. The germ filament which they produce springs habitually from the side, at a short distance from the hilum, which indicates the point of attachment to the original spicule. These filaments will attain to from fifteen or twenty times the diameter of the spore in length before branching, and are in themselves exceedingly delicate.

It should also be remarked that the spore-bearing tubes, or filaments, which issue from the primary bilocular spores (protospores), are not always simple, but sometimes furcate; and the cells which are ultimately formed at their extremities, though producing filiform processes, do not always generate secondary spores (teleutospores) at their apices. The processes become very greatly elongated, when they are thus barren, and may fulfil some other purpose. Gasparrini observed the same thing in the *Podisoma* which he examined.*

The whole process of germination thus described in *Podisoma* is so similar to that of other Uredines, especially *Triphragmium* and *Puccinia*, that we cannot admit a doubt of their intimate alliance. Tulasne, mentally associating these Tremelloid Uredines, with the true Tremellas, has applied to the bilocular spores the objectionable term "basidia." It were better that some such term as "protospores" should be employed in order to prevent confusion. The secondary spores, produced on the germinating filaments of the protospores may be fitly characterized as "teleutospores." In

* "Osservazioni sulla generazione delle spore nel Podisoma fuscum;" lower fig. 7.

justification of the term "basidia," as applied to the protospores of *Podisoma*, Tulasne observes that "the pretended bilocular sporidia of these fungi become organs analogous to the basidia of the Tremellæ and Exidiæ, which are divided into two or four cells,* consequently the tubes or filaments which spring from these sporidia must be a kind of spicules, or compound sterigmata, which their large dimensions and special structure doubtless render very different from the ordinary sterigmata of the Hymenomycetes, but which are evidently allied to the singular spicules which are proper to the Tremellæ. Finally, the spores of *Podisoma* have completely the form and organisation of the spores of *Tremella mesenterica*, and are similarly attached to their immediate support," and again he says, "the affinities which ought to be recognised between the *Podisoma* and the *Tremellæ* have not all their foundation in the reproductive apparatus. The body itself, or the parenchyma, presents an organization which is tolerably analogous to that of the Tremellini, since it is exclusively formed of long filaments and the thick mucilage which holds them together; only these filaments are nearly solid, so thick is their constituent membrane, and they are but rarely ramified. In *Podisoma juniperi-communis* (Fr.) they undergo, at the period of the dissemination of the spores, a kind of dissolution which confuses their substance with the surrounding mucilage. Those of *Podisoma fuscum* (Corda) are preserved longer entire and distinct, but finally experience the same fate."

These views were subsequently modified considerably, after a more complete acquaintance with the germination of the Uredines, and in the communication to the French Academy already cited, Tulasne expressed his full conviction that the true affinities of *Podisoma* were with the Uredines.†

Of late years the attention of mycologists has been directed very much to a kind of alternation of generation which takes place amongst the Uredinous Fungi. De Bary and Tulasne have each contributed something to the history of these extraordinary phenomena; but the relations of the Tremelloid Uredines to other fungi have only been studied by Dr. Oersted, of Copenhagen, who maintains, as the result of his experiments, that all the species of *Podisoma* are but conditions of the horned cluster cups *(Ræstelia)*,

* See Tulasne in "Annales des Sciences Nat.," 3rd Ser., vol. xix. (1853), pp. 193, et. seq.
† Comptes Rendus, 20th June, 1853.

which are developed upon rosaceous trees. The first experiments were directed towards *Gymnosporangium juniperi*, called by him *Podisoma juniperinum*. The course of his experiments are thus detailed by himself:—*

"On the 19th of May (1866) some fresh gathered specimens of the *Gymnosporangium* were damped with water. During the night the spores commenced to germinate in great quantity, and the sporoids (teleutospores) were so abundant that they formed an orange coloured powder.

"On the 20th, in the morning, I deposited, by means of tweezers, a little of this powder upon the leaves of five small sorbs *(Pyrus aucuparia?)*, and after having damped the sown parts with some drops of water, I placed the plants under bell glasses, in order to keep up the necessary humidity, and to keep away all foreign influences.

"On the 25th I had the satisfaction of seeing upon the leaves some yellow spots due to the development of the mycelium, and on the 26th and 27th little pustules began to form, indicating the appearance of the spermogones. The sporoids (teleutospores) germinated some hours after being detached, and this germination consists in this—the cellular membrane upon the sides, or on the top of the cellule, prolongs itself into a very slender tube, the point of which perforates the cuticle of the leaves. At its commencement it is thick, and filled with a protoplasm of a grey (*sic.*) colour. When it developes its mycelium, which it does at the end of a few days, it invades the tissue of the leaf, and, in destroying the chlorophyll, produces some circular yellow spots.

"After the spermagones had discharged all their spermatia, and were dry, no change of the leaves was shown until the end of June. At that time the cellular tissue began to swell in the form of pads upon the inferior face of the leaves, precisely under the point occupied by the spermogones upon the superior face; and in the course of July the peridia appeared. Thus all the development was terminated towards the commencement of August.

"This trial of spores has conduced to the result expected, and proves that the teleutospores of *Podisoma* (*Gymnosporangium*) *juniperinum*, when transported upon the Sorb (in nature by the

* Oversigt over det Kongl. Danske Videnskabernes Selskabs (1866), p. 185, t. 3, 4. Résumé du Bulletin de la Société Royale Danoise des Sciences (1866), p. 15.

aid of the wind) give rise to a totally different fungus, the *Ræstelia cornuta*, that is to say, that an alternate generation comes between these fungi. They appertain in consequence to a single species (*Ræstelia cornuta*), and *Podisoma* (*Gymnosporangium juniperinum*) ceases to be an independent species, and must be considered as synonymous with the first generation of the *Ræstelia*."

"The spores (of Ræstelia, it is presumed) have been transported upon young shoots of the juniper tree, and have now commenced to produce some mycelium in the bark. There is no doubt that in next spring it will result in *Podisoma* (*Gymnosporangium*) *juniperinum*."

This is Dr. Oersted's report of the results of his experiments, and although not prepared to accept them as absolutely true until confirmed by other observers, we cannot ignore the fact that some mycologists have at once, and we think too rashly, accepted the conclusions.

Subsequently the same gentleman, who is Professor of Botany at the Copenhagen University, made other experiments upon other hosts with the spores of *Podisoma*. He professes, by similar means as in the other instance, to have demonstrated that *Podisoma Sabinæ*, and *Ræstelia cancellata* are alternate generations of the same species.* This *Podisoma Sabinæ* is the same as we have called *Podisoma fuscum* in the present communication.

Further, he claims to have established the fact that *Podisoma clavariæforme* (the *Podisoma juniperi-communis* of Fries) is the first generation of *Ræstelia lacerata*, which thrives upon the hawthorn and the apple.

He observes that there are three *Ræstelias* found in the north, *R. cornuta*, *cancellata*, and *lacerata*, and all other forms are varieties of these. That three Podisomas are also found in the same region —*P. gymnosporangium*, *juniperi*, and *fuscum*. And that these are alternate generations, the one of the other.

Podisoma.		Ræstelia.
gymnosporangium	=	cornuta
fuscum	=	cancellata
juniperi	=	lacerata

* Oversigt K. Danske Videns. Selskabs (1867), p. 208, t. 3. 4. Résumé du Bulletin de la Soc. Roy. Danoise des Sciences (1867), p. 38. Botanische Zeitung (1867), p. 104.

The *Podisoma*, which is found exclusively upon the leaves of junipers in Denmark, has also received notice. Oersted is convinced that it is only a folicolous form of *Podisoma juniperi*, and that the figure and description given by Corda* of *Podisoma juniperi minor* belong to it, since the figures accord so exactly with the forms found at Hoiljerg; and he adds to this, "the place I assign to it is perfectly exact, since it is identical in its spores with that which thrives upon the branches." It must, therefore, be very different from the *Podisoma foliicolum* of Berkeley, which, neither in appearance nor fructification, resembles *Podisoma juniperi*.

The question naturally suggests itself as to what are the probabilities in favour of the accuracy of Oersted's observations. Are the Ræstelias only conditions of the Podisomas? We confess to a little difficulty in accepting the conclusion as the matter stands. We would not deny, neither can we affirm it. If true, how are we to explain cases in which pear trees are infested with the *Ræstelia* without a Savin growing within a radius of very many miles? Or how can we account for the *Ræstelia* on the hawthorn in localities where junipers are unknown? Is an annual impregnation necessary, or can one be produced without the other, under any circumstances? Anyhow, this alternation of generations in plants, fixed to determinate spots, is a mystery far greater than such phenomena in animals that are locomotive. Mysterious as it may be, we are bound to accept the facts if satisfactorily confirmed, although we cannot account for all the phenomena.

If true, which is the early stage, the *Ræstelia* or the *Podisoma*? We should elect in favour of *Ræstelia*, commencing with the spermogonia, because, if the spermatia have any fertilizing function this would precede the germination of the *Ræstelia* spores. No spermatia having as yet been discovered in connection with the Podisomas themselves, but always preceding the *Ræstelia*.

The Tremelloid Uredines have been grouped under two genera, namely, *Podisoma* and *Gymnosporangium*. As far as we can judge there seems to be no good grounds for this separation. The written characters of the two genera present as a distinction the external form alone, which is more or less expanded in *Gymnosporangium*, and clavate or clavariæform in *Podisoma*. Internally and microscopically, as far as we can ascertain upon close examination, the

* Corda, Icones Fung., vol. i, p. 8., t. ii. f. 122.

structure is the same. In fact we are not alone in this opinion, as Bonorden includes *Gymnosporangium juniperi* (Fr.), the only described species, under *Podisoma*, as *Podisoma gymnosporangium*.* It will be seen that *Podisoma foliicolum* of Berkeley is very much further removed from *Podisoma* than *Podisoma* from *Gymnosporangium*. In fact, it is not a very near ally of either. For the present we shall continue to speak of *Gymnosporangium juniperi* under its usually accepted name. The normal form occurs in the United States as well as in Great Britain, but recently Mr. C. H. Peck has sent us from Albany, N. Y., a variety upon the common cedar (*Juniperus Virginiana*), which is smaller in its external development, so far as our specimens go, but with marked difference in structure. The hyaline peduncles of the protospores are thicker than in the typical form at their smallest diameter, and these expand upwards until they attain very nearly the diameter of the protospores, reaching which they are constricted deeply, so that the peduncles are most conspicuously clavate (pl. xviii., fig. 3). The protospores are rather more brightly coloured, nearly the same in size, but rounded above, so that each cell is less triangular than in the typical form. This is at least a well-marked variety, and as such we have called it, variety *clavipes*. A better acquaintance with its ultimate development, and specially of its teleutospores, is essential before determining its claims to be considered specifically distinct.

Of *Podisoma* three good species are recognized. The *Podisoma Juniperi-communis* of Fries, with very long protospores (pl. xix., fig. 1). The *Podisoma fuscum* of Corda†, which is also the *Podisoma Juniperi-sabinæ* of Fries, with short protospores (pl. xix., fig. 2), and the *Podisoma macropus* of Schweinitz, with protospores of a length intermediate between the other two (pl. xix., fig. 3). Corda was manifestly wrong in referring *Podisoma Juniperi communis* of Fries as a synonym of his *Podisoma fuscum*.

Podisoma juniperi is very common on the juniper (*Juniperus communis*) in Britain in the spring. The branches on which it occurs are swollen at the infected spot to nearly double their normal size, and the orange tremelloid masses of the fungus are protruded through orifices of the bark like spines. As winter approaches all external manifestations, except the gouty swellings, disappear, and

* Bornorden, Handbuch der Allgem: Mykologie (1851), pp. 148.
† Corda, Icones Fungorum, vol. iii., p. 36, t. vi., fig. 93.

reappear again the following spring for many successive years. The same parasite in the United States attacks the cedar (*Juniperus Virginiana*). Corda,* Rabenhorst,† and some other authors, have erroneously described the *Podisoma* as growing on dead or dying branches, whereas it always appears on trees and branches which are vigorous and full of life. As M. Tulasne remarks, the exuberance of vegetation which they determine locally in the plant that nourishes them is comparable to what is caused by the punctures of *Cynips* and other gall-producing insects.

Podisoma fuscum is found in Britain, and some other parts of Europe on the savin (*Juniperus Sabinæ*). Tulasne collected it in Provence on *Pinus halepensis* and *Juniperus Oxycedrus.* In the United States it occurs sometimes on *Juniperus Virginiana*, but does not appear to have been detected until sent to us this year by Mr. Peck. Of its identity there can be no doubt. It causes the swellings known as Cedar Balls, in the same manner as its ally, *Podisoma macropus*, but, both externally and internally, gives evidence of being the species to which we have referred it. This species may be known from *P. juniperi* by its general form, dark colour, darker protospores, and teleutospores, and by the greatly different form of the protospores. The teleutospores are nearly of the same form in both species.

Podisoma macropus ‡ is a North American species, never having been detected in the Old World. It is the most common species on the cedar (*Juniperus Virginiana*), which is therefore the unfortunate host that supports in the New World not only its own special parasite, but also the *Gymnosporangium*, and both the other species of *Podisoma*. This is evidently the *Podisoma Juniperi-Virginianæ*, of Fries. Dr. Wyman§ has well characterized it as growing on the branches, and also on the slender twigs which form abnormal tufts on the cedar. On the branches excrescences are formed which resemble galls, and these are called "Cedar Apples." The surface is "generally marked with small depressions, from which at certain periods there projects a small point varying in length; this process consists entirely of fungi, which are developed

* Corda, Icon. Fung., vol. iii., p. 36.
† Rabenhorst, Deutschl. Flora, vol. i., p. 29.
‡ Schweintz in "American Philosophical Transactions." New Series, vol. iv. (1834), p. 307. No. 3096.
§ J. Wyman, in "Hooker's London Journal of Botany," vol. iv. (1845), pp. 315-319, t. xii., f. 6.

in a cell, the external coverings of which are ruptured as the fungus increases in size (inexact). When wet they absorb moisture very rapidly, swell and become much elongated. In the cedar apple they often project to the distance of an inch, and hang down like tassels. In localities where the juniper is abundant these excrescences exist in large quantities, so that after a rain the trees have the appearance of putting forth large numbers of flowers, in consequence of the sudden elongation of these collections of fungi." Schweinitz remarks that the cedar apple always precedes the external manifestations of the fungus, swelling and increasing into a more or less turbinate head, which is traversed by the branch and attains a diameter of one or two inches. "When flourishing it is easily cut and eaten, like an apple, and becomes hard when dried. Externally, there is an epidermis-like bark, of a brown purplish lilac tint, and altogether juiceless, like the peel of an apple. The whole surface is regularly dotted with polygonal, usually pentagonal foveola, which are at first plane, but presently dimpled and umbonate; at length, the bark being ruptured in the centre, the ligulate tremelloid sporidochia burst forth in moist weather about an inch in length, of the most beautiful orange colour, adorning in the course of a single spring night the whole tree as it were with the richest crop of ripe oranges. If wet weather continues for many days, it remains in this state till the ligules melt away. Under the influence of the sun, however, they soon dry up, and never revive. The apples last for a year. In general, when the junipers are cut into a pyramidal, or other form, they are covered with an incredible quantity of these fungi, but according to observations which I have carefully made for ten years it does not destroy them, nor does it even seem to injure them." *

The protospores in this species are shorter than in *P. juniperi*, and longer than in *P. fuscum*. The teleutospores do not seem to have been examined at present, and our own specimens failed to germinate. They probably resemble those of allied species. This is a desideratum which we commend to the notice of American mycologists. The orange strap-like masses are double the length of those produced by *P. fuscum* on the same species of juniper.

The *Podisoma* of Gasparrini, which he calls *Podisoma fuscum*, cannot be that species, if his drawings are accurate, for the proto-

* M. J. Berkeley, in "Hooker's London Journal," iv. (1845), p. 318, t. xii., fig. 6.

spores are more like those of *Podisoma macropus*. Tulasne has pointed this out in a note to his memoir on the Tremellini, wherein he says, "it would rather constitute a species distinct both from *P. fuscum*, Corda, and *P. juniperi-communis*. Fr. The species examined and figured by Gasparrini was found on another species of juniper (*Juniperus Phœnicia*).

A species of *Podisoma* is recorded by Opiz under the name of *Podisoma callunæ*,* as having being found in the neighbourhood of Prague, but of this we have no knowledge, nor of its having been met with by any other mycologist. We can only refer to it as an uncertain species. *Podisoma Bulliardi* (Bonorden) is not a *Podisoma*, but allied to *Coryneum*.

Podisoma foliicolum is the name given by Berkeley,† in the English Flora, to a parasite on the leaves of the Savin (*Juniperus Sabinæ*.) It makes its appearance in spring, on the living leaves, as small, subelliptic, pitchy black excrescences, not larger than the head of a pin. Internally it consists of a rather tremelloid stroma, from which radiate long hyaline peduncles, surmounted each by an elliptical, or sub-fusiform spore, of a dull brown colour when mature, and divided by three, rarely five, transverse septa (pl. xix., fig. 4). In the description cited, the spores are said to be "very obtuse;" this is by no means constantly the case, as, in the specimen before us, the majority of the spores are acute at both extremities, so that the spore is more accurately described as broadly-lanceolate than elliptic. The behaviour of these masses, when placed in a drop of water under the microscope, is very different from those of *Podisoma*. The spores do not adhere with any tenacity to each other, but float over the field quite freely; in fact, they do not seem to be involved in gelatine at all, but resemble, in many respects, the spores of *Coryneum*, to which this plant is certainly more closely related than to *Podisoma*. Fuckel‡ has recently transferred it to *Hendersonia*, a genus with which it has as little affinity as *Podisoma*, for there is no definite perithecium (one of the essential characters of *Hendersonia*). The specimens published by Fuckel§ are said to be on the leaves of the common juniper (*Juniperus-communis*), but there is no appearance of any essential difference. The spores (or protospores) are not

* Opiz, Seznam rostlin kvëteny ceske v. Praze (1852), p. 136.
† Engl. Fl. v. part ii., p. 362. Cooke's Handbook, p. 510, No. 1518.
‡ Fuckel, Symbolæ Mycologicæ 1869), p. 391.
§ Fuckel, Fungi Rhenani, No. 414.

uniseptate, as in *Podisoma*, but at least triseptate, a difference as great as between *Puccinia* and *Triphragmium*. They are *not* involved in gelatine as in *Podisoma*. They have not been shown to germinate, and produce teleutospores as in *Podisoma*, and they do not "spread out above into a clavariæ-form mass." For all of these reasons we think that the *Podisoma foliicolum* of Berkeley cannot be retained in that genus, or amongst the Uredines, but must be removed into close proximity with *Coryneum* amongst the *Melanconiei*. That it is not a good species of *Coryneum* is admitted, and for that reason it is proposed to constitute it the type of a new genus, under the name of *Sarcostroma Berkeleyi*. *

The *Podisoma Juniperi minor* of Corda, already alluded to, has by some authors, been considered identical with *Podisoma foliicolum* of Berkeley, but Corda figures only one septum in the spores. Fuckel therefore is wrong, and our "Handbook" also, in referring Corda's species to *Podisoma foliicolum*. Oersted's testimony that the *Podisoma* figured by Corda on juniper leaves is identical with that of the stem and branches, is doubtless correct. Tulasne's opinion † that Corda's plant is not a *Podisoma* at all, was probably founded on Corda's figure, mentally associated also with Berkeley's species, under the impression that both were the same thing.

These remarks may fitly be closed with an enumeration of the species as they would stand if Oersted's observations are confirmed.

1. PODISOMA GYMNOSPORANGIUM, *Bon.*

SPERMOGONIA—Spermatia cylindrical, obtuse.

PERIDIA=*Ræstelia cornuta*. Tul.
On leaves of Mountain ash, &c.

PROTOSPORES—Elliptical, uniseptate, constricted.

TELEUTOSPORES—Obovate or elliptic, slightly curved.
On living Junipers.

var. CLAVIPES—*C. & P.*—Peduncles of protospores clavate.
On living *Juniperus Virginiana*. [United States.]

2. PODISOMA JUNIPERI, *Fr.*

SPERMOGONIA—Spermatia subfusiform.

PERIDIA=*Ræstelia lacerata*. Tul.
On leaves of hawthorn, &c.

PROTOSPORES—Lanceolate, uniseptate, constricted.

TELEUTOSPORES—Obovate or pyriform.
On living Junipers.

* SARCOSTROMA. Erumpent. Spores septate, on very long peduncles, radiating from a gelatinous stroma.

† Tulasne, Annales des Sc. Nat. ser. iv. (1854), ii., p. 186.

3. PODISOMA FUSCUM, *Duby.*

SPERMOGONIA—Spermatia cylindrical.
PERIDIA=*Rœstelia cancellata.* Reb.
On leaves of Pear, Apple, &c.
PROTOSPORES—Elliptical, narrowed at each extremity, uniseptate, constricted.
TELEUTOSPORES—Elliptical, or subcymbiform.
On living Junipers.

4. PODISOMA MACROPUS, *Schwz.*

SPERMOGONIA } Unknown.
PERIDIA }
PROTOSPORES—Broadly lanceolate, uniseptate, constricted.
TELEUTOSPORES—Obovate.
On living *Juniperus Virginiana.*

SPECIES DOUBTFUL.

Podisoma fuscum. *Gasparrini.*
Podisoma callunæ. *Opiz.*

SPECIES EXCLUDED.

Podisoma foliicolum. *B. & Br.* = Sarcostroma Berkeleyi. *Cooke.*
Podisoma Bulliardi. *Bon.* = Coryneum or Sarcostroma.

DESCRIPTION OF PLATES XVIII. AND XIX.

PLATE XVIII.

Fig. 1.—Portion of *Podisoma Juniperi* with the protospores germinating.

Fig. 2.—Protospores of *Podisoma gymnosporangium.*

Fig. 3.—Protospores of *Podisoma gymnosporangium.* var. *clavipes.* C. & P.

PLATE XIX.

Fig. 1.—Protospores of *Podisoma Juniperi.*

Fig. 2.—Protospores of *Podisoma fuscum.*

Fig. 3.—Protospores of *Podisoma macropus.*

Fig. 4.—Fructification of *Sarcostroma Berkeleyi.*

On the so-called Boring or Burrowing Sponge.

By J. G. Waller.

(*Read September 22nd*, 1871.)

Cliona celata (Grant). Halichondria Celata (Johnston). Hymeniacidon Celata (Bowerbank).

There is nothing more commonly witnessed in historical literature, or in the records of science than the persistency of error. This is especially the case if it contains something of the romantic or of the marvellous. A writer of credit puts forward a statement; he may, or he may not, give an authority for it: let it be accepted without dispute, it gets copied by one writer after another and passes as an established fact. At length an inquisitive eye, by chance perhaps, happens to refer to authorities, and it is found, either that they are inconclusive, or, as it has often happened, absolutely disprove the statement which has long been accredited. In fact, though it is not flattering, man has much of the sheep in his composition, and likes to follow a bell-wether.

The errors and the dreams of science have been very numerous. We have had the flints on the upper chalk formation attempted to be accounted for as the coprolites of whales; the 16th and 17th century gives us the wonderful story of the goose which developed from barnacles, and now we have a " burrowing or boring sponge." I say now, for the delusion has been ably exposed by Dr. Bowerbank, in his admirable monograph on the Spongiadæ, and I should have considered it impertinent, on my part, to have entered into the subject had I not recently heard an eminent professor of geology assert the old story, which is also reproduced circumstantially in a very popular work on the microscope, and in its last edition. It is extraordinary how completely it has been accepted, and how widely disseminated.

It is asserted in Ray Green's useful manual on the " Protozoa,"

Professor Owen's "Palæontology,"and in numerous other works of a less scientific value, such as "Recreative Science," &c. In fact, with the single exception of Dr. Bowerbank, I know of no one writing upon sponges who does not still continue to speak of a "boring sponge." To those who have no experience in the growth of these organisms the proposition may not involve any great difficulty. I have, therefore, thought it a proper subject for discussion in our Society; first, as a duty we owe to each other, to give the result of our observations; secondly, because, besides supporting Dr. Bowerbank's views, I shall be able to add facts on the physiology of the sponge, which do not appear to have fallen under his observation; and I hope the result will be that, with our numerous observers, we shall be enabled to prove that a "boring sponge" is about as true a fact as the "barnacle goose."

I will now quote from the work on the microscope to which I have alluded, as the passage, fortunately for our purpose, has condensed and brought together all the popular ideas, and what I assert to be, errors on the subject:—

"*Cliona.*—Not the least wonderful circumstance connected with the history of sponges is the power possessed by certain species of boring into substances the hardness of which might be considered as a sufficient protection against such apparently contemptible foes. Shells (both living and dead), coral, and even solid rocks, are attacked by these humble destroyers, gradually broken up, and no doubt finally reduced to such a state as to render substances which would otherwise remain hard and useless in the economy of nature available for the supply of the necessities of other living creatures.

"These boring sponges constitute the genus *Cliona* of Dr. Grant. They are branched in their forms, or consist of lobes united by delicate stems; they all bury themselves in shells or other calcareous objects, preserving their communication with the water by means of perforations in the outer wall of the shell. The mechanism by which a creature of so low a type of organization contrives to produce such remarkable effects is still doubtful, from the great difficulties which lie in the way of coming to any satisfactory conclusion upon the habits of an animal that works so completely in the dark as Cliona Celata; it probably will long remain so.

"Mr. Hancock, to whom we are indebted for a valuable memoir upon the boring sponge, published in the 'Annals and Magazine

of Natural History,' attributes their excavating power to the presence of a multitude of minute siliceous crystalline particles adhering to the substance of the sponge; these, he supposes, to be set in motion by some means analogous to ciliary action. In whatever way this action may be produced, however, there can be no doubt that these sponges are constantly and silently effecting the disintegration of submarine calcareous bodies, the shelly covering, it may be, of animals far higher in organization than they; nay, in many instances, they prove themselves formidable enemies even to living mollusca, by boring completely through the shell. In this case the animal whose domicile is so unceremoniously invaded has no alternative but to raise a wall of new shelly matter between himself and his unwelcome guest, and in this manner generally succeeds at last in barring him out.— *Vide* Hogg on the Microscope,' pp. 285, 286."

It would not be difficult to criticize this passage, in which a series of assumptions are treated as conclusions, and in which there is really no evidence whatever. But it is fair to the writer to say that, he only repeats what another has advanced, and which he finds to be generally accepted. Before I enter into the general subject, some account of the scientific history of this organism is required.

Its discovery is due to Dr. Grant, a name always to be spoken of with respect. He found it protruding from orifices in an oyster shell, and on touching it with a needle it retracted, and withdrew within the aperture. He considered it to be a zoophyte, and named it "Cliona Celata." Dr. Johnston brought it into its proper place amongst the family of sponges, calling it "Halichondrin Celata." Then comes another observer, Mr. Hancock, who, in a most elaborate and interesting article in the "Annals and Magazine of Natural History," N.S. vol. iii., p. 332, &c., first pronounces it to be a "boring or burrowing sponge," and divides it into twelve species. In this article he candidly admits, that the prevalent opinion *then* was, that the sponge did not excavate the burrows in which it lived, but that those were the work of worms. This view, however, he combats strenuously, as he says, "were this belief correct, the chambers would occasionally occur only partially occupied. *This never happens.*" Now, "*this never*" is unlucky. It does so happen that the excavations are not always filled, on the contrary are often entirely empty, and sometimes only partially occupied. On this point I have abundant evidence. I have recently seen oyster shells

entirely perforated with minute borings about the twentieth of an inch in diameter, without the slightest vestige of the sponge in any part; and Dr. Bowerbank has produced such overwhelming testimony that in itself it is sufficient to dispose of this statement. Dr. Bowerbank states that, he has found it in the interior of the shells of Balani, and has also found it filling up excavations made by lithodomus molluscs in the rocks at Tenby. To this, I can add, that I have found it in the empty tubes of the Serpula. Dr. Bowerbank further states that "I have in my collection several specimens of large Balani, which I took from the sides of rocks forming the Guliot caves at Sark, which are perforated, in the usual manner, with numerous sinuous canals, which I found filled with the *living annelids*, the dried remains of which *still remain* in them, and without the slightest indication of the presence of *H. Celata*, and I have also found *living* annelids in the deeply seated portions of the perforations in the limestone boulders of Tenby, beyond the range of the sponge; so that I think it may be reasonably concluded, that the sponge occupies the canals and cavities in shells and stones which have been excavated by other animals, and that they have no power to excavate such residences themselves." (Vide "British Spongiadæ, Art. Hymeniacidon Celata.")

I hold it as impossible for any one, who enters into the study of this sponge with unprejudiced views, to arrive at any other conclusion. It is necessary, however, for me briefly to state what means Mr. Hancock has considered the sponge has for the work he attributes to it. He says "The excavations are effected by mechanical and not by chemical means. With respect to *Cliona*, it is well known to possess silicious spicula, some of the points of which penetrate the surface of the animal, and might be supposed capable of reducing the calcareous bodies in which these creatures bury themselves." To my mind this process would be about as effectual as mining the tunnel of Mont Cenis with darning needles. "But," the writer continues, "other and apparently more efficient agents have been discovered covering the surface of the sponge"—and these he minutely describes, and has figured as "certain silicious particles." Now, silicious particles are commonly enough found on the tissues of nearly all sponges. I have a specimen of the genus Chalina, which is rendered quite rigid by the dermis being filled with extraneous grains of sand not in any way united to the fibres of the network. The instance is remarkable, but I look

upon it as abnormal. But in *Dysidea fragilis* we have the whole structure of the skeleton made up of silicious particles, enveloped or agglutinated by the keratose fibres. Had this "boring sponge" possessed such a structure, one might, perhaps, be persuaded it had the power attributed to it; unfortunately, it is one of the simplest and feeblest of its class, consisting chiefly of thin structureless membranes upon which spicula are indiscriminately thrown. But the "silicious particles," which Mr. Hancock said he found after he application of nitric acid, and which he has figured, have a prismatic form, which suggests that he has in some way or other deceived himself. That this was the case seems evident, for he sent his specimen, which contained these erosive organs, to Dr. Bowerbank, who discovered that they were only disintegrated cells of carbonate of lime—the *débris*, in fact, left by the annelid, by whom the perforations were made. Such I have myself often seen, the sponge having covered them by its membrane during its growth, showing that they must have been the product of a previous "borer." And it suggests to us this question—What did the "boring sponge" do with the materials it removed? They must have passed through the excurrent canals, and it is inevitable that in doing so these canals would be found with numerous particles adherent to their surfaces. None, however, are found. Then, again, if the sponge was a miner, he would have his tools at the most distant part of his mine, where he was engaged in enlarging his dwelling. Now what do we find here? A thin, pellucid membrane, so transparent that it is scarcely to be distinguished from the colour of the shell it covers, having more the appearance of a varnish than anything else. Indeed, we should not be conscious of any structure but for a few scattered spicula which lie upon its surface. Nothing can be more consistent than this appearance in a growing sponge; nothing less so in a sponge which is said to make the dwelling it occupies. We cannot possibly imagine a structure, so feeble capable even of conveying the power of excavating at all without an entire subversion of the mechanical law, viz., *that an effect cannot be greater than its cause.* The feeble, simple character of this organism seems indeed to give us the reason of its seeking for a protection in holes and corners from external attacks. It is remarkable, however, that it does not get into any opening that lies in its way. It does not build in the sand-constructed tubes made by some of the annelids, nor in mere crevices;

it seeks the more complete protection offered by burrows or hollows, vacant spaces having more secure walls. Another very interesting sponge, which I found abundantly on the same oyster-shell which has given me so much information on this "boring sponge," does, however, build within crevices and parts of the sand-built tubes just alluded to.

I will now turn to some points of great interest which seem not hitherto recorded. I have here a section (Fig. 1.) representing the burrows filled with the sponge. At its distal extremity, as I have already mentioned, where is the latest growth of the sponge, we find the membrane pellucid, with but few spicula. Going back into the older portions, this membrane gets gradually more full of colour, denser in character, the spicula increasing in number, until they become almost matted together. We then come to that part on the edge of the shell where the laminæ are wide and open, whose spaces, beside the burrows and connecting with them, the sponge has occupied, and here has communication with the outer world. Hitherto the dermal membrane has been protected by the shell it covers; now, as this is wanting, we find the means it takes for that purpose singularly effective. The spicula in all other parts of the sponge have been irregularly disposed on the membranes, which is a mark of the genus to which Dr. Bowerbank has given the characteristic name of *Hymeniacidon*. But here they form themselves into a regular wall, closely packed together, parallel to each other, so as to present a formidable array of pikes to any adventurous intruder who would attack the domicile. (Fig. 2.) The sarcode here thickly overlays and invests it. Here are found the pores—the inhalent organs—not, however, very conspicuous, but sometimes distnctly seen with an inch lens. So that, instead of finding the sponge in possession of an apparatus of attack and destruction, which has been assigned to it, we see that its offensive powers, if we may so call them, have been concentrated into a system of defence, to screen it from assaults from without; and that no part of the sponge has so powerful an organizaton as this prepared for its protection.

It is natural now that we should pass to consider those organs by which the excretory function is performed, viz., the oscula. The excretory organs of a sponge are always remarkable, whether they consist of simple oscula, or whether of a number of oscula pouring their contents into a common sewer or cloaca. In many

the shape of the sponge itself is defined by them. In this case the organ, which performs this office, was that which first led to the discovery of the sponge by Dr. Grant. Though this eminent observer referred it to a zoophyte, he describes the organ itself with characteristic accuracy. He says "The projecting tubular papillæ possess a complicated structure, and a high degree of contractile power, and exhibit a singular series of appearances when the zoophyte is attentively examined whilst at rest in pure sea water." When under water, the papillæ are seen projecting from the apertures of the shell sometimes to the length of a line and a half. They present a wide circular opening in their centre, and a rapid current of water issues constantly from them, conveying occasionally flocculi of a grey membranous matter. But on being touched with a needle, or withdrawn from the water, the opening gradually closes, the current ceases, and the whole papilla, continuing slowly to contract, is withdrawn completely within the aperture of the shell. The papillæ viewed in their contracted state, present a smooth, rounded, short extremity; but when they begin to advance beyond the surface of the shell, their extremity becomes flat and slightly dilated, assumes a villous appearance, with open fissures radiating from the centre to the margin of the papilla, and at length a minute circular opening is perceived in the centre of the villous surface. The papilla advances from the shell, and its central opening enlarges in proportion to the healthy state of the zoophyte, and the purity and stillness of the water; its flat, downy, radiated surface, gradually diminishes by the widening of the central opening, till only thin margins are left around the orifice, and the current is again seen to play briskly from it."

This organ, so well described by Dr. Grant, is the osculum of the sponge, and the small perforated orifices of the shell are, for the most part, thus made use of for its protrusion, and the exercise of the excretory functions. It is rarely that these orifices are not so used, but in some instances, instead of the osculum, they are closed up by dermal membrane, fortified in the manner I have previously described. In one of my specimens I am fortunate in having one of these oscula preserved in its protruded state. (Fig. 3.) Its spicula are, for the most part, concealed by thick fibrous membranes, but appear at the apex of the cone, upon which a grain of silex rests, as if to give an argument to those who support the "boring"

theory. It is, however, drawn from a dried, and not a living specimen.

Dr. Bowerbank does not describe nor seem to have seen the ova nor any organs of reproduction of this sponge. He, however, quotes Dr. Grant, who states that "during the months of March and April, when his observations were made, numerous small yellow ova were seen in the vicinity of the canals, agreeing much in their form, size, and mode of distribution with those of Spongia papillaris and S. panicea." It was at the end of the month of March that I procured the oyster which has afforded me so much information on this subject. And, in secluded nooks of the excavations, generally nearest to the older and more mature portions of the sponge, I found numerous ovaria, using the distinction Dr. Bowerbank makes between them and the gemmule, embedded in the sarcode and protected by a somewhat rudely-formed network of fasciculi of spicula. They were oval in shape, and measured about 133rd of an inch in their long diameter. (Fig. 4.) When mounted in Canada balsam these were found to consist of numerous vesicles or ova, not dissimilar from those found in the fresh-water sponges. In their natural state they are of a bright yellow colour, and semitransparent, but when about to leave their investment become denser, paler, and more opaque. To view their general appearance and arrangement they are better mounted dry, but the vesicles cannot be seen until mounted in balsam. Besides these organs there are others much more minute, being simple, ovate cells, and these are not collected together in particular spots, but are found scattered over the membranes, sometimes in such quantities as to resemble the spores of a fern, and often giving a deep chocolate hue to the membranes. They are generally much more numerous near the mouths of the oscula, where they seem to be in the act of escaping from the parent. They measure 2150 of an inch in the long diameter. (Fig. 5.)

What relation these may have to the other I cannot presume to say; it is a point for other observers to take up.* And it is important to let the time for study be the months of March and April, when they are developing into maturity. Not but what it is necessary to observe such organisms as sponges at all times of

* Possibly these may be spermatozoa.

the year, as it is certain that something will be learned at opposite seasons, for much remains to be discovered.

Of the numerous varieties of this sponge in Britain, constituted by Mr. Hancock, Dr. Bowerbank specifies eight, viz., Cliona Gorgonides, C. Gracilis, C. Howsei, C. Northumbrica, C. Alderi, C. Corallinoides, C. Lobata, C. Vastifica. All these Dr. Bowerbank disallows, as he says, "they are founded purely on differences in form, without any adequate variations in their structural characters to support such a division." It is so undesirable to multiply varieties, that Dr. Bowerbank's conclusions may be accepted with some satisfaction.

There is but one form of spiculum properly belonging to this sponge. (Fig. 6.) It is that which the worthy author of the "British Spongiadæ" calls "Enormi Spinulate." Having a preference to Saxon-English, I should substitute "somewhat pin-like," as conveying a more ready idea to the unlearned, and, I hope, intelligible to the learned. This form pervades all parts alike, whether they are upon the dermal or upon the interstitial membranes. There does not seem much tendency to vary from it to any great degree, and the figures given by Mr. Hancock are doubtless accidental forms, as Dr. Bowerbank suggested, belonging to other sponges, and not to a variety of this genus.

As the further investigation of this organism is easy, as you have only to select an old and well-drilled shell, I trust my fellow members will soon convince themselves, if I have not done so, that a "boring or burrowing sponge" is about as true a fact in science as the "barnacle goose."

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DESCRIPTION OF PLATE XX.

Fig. 1.—Vertical section of oyster shell with sponge.
a. a. a. dermal membrane; *b.* ovaria.
Fig. 2.—Dermal membrane, more highly magnified.
Fig. 3.—Osculum protruded, dried specimen.
Fig. 4.—Ovaria.
Fig. 5.—Spermatozoa? and spicules.
Fig. 6.—Spiculum.

PROCEEDINGS.

September 22nd, 1871.—*Chairman*, Dr. Lionel S. Beale, F.R.S., &c., President.

The following donations to the Club were announced :—

"Land and Water" (weekly)...	from the Editor.
"Science Gossip"	the Publisher.
"Monthly Microscopical Journal"...	the Publisher.
"The American Naturalist"	in exchange.
"Flint," a paper by Mr. Hawkins Johnson ...	the Author.
"The Proceedings of the Geologists' Association"	the Secretary.

The thanks of the Club were unanimously voted to the donors.

Mr. Waller read a paper "On Boring and Burrowing Sponges," illustrating the subject by diagrams.

The President proposed a vote of thanks to Mr. Waller for his extremely interesting paper, feeling sure that all present must have listened to his remarks with great pleasure.

The vote of thanks was then carried unanimously, and discussion upon the subject was invited.

Mr. Henry Lee said he was quite sure that everyone present would agree with him in regarding any opinions of so high an authority as Dr. Bowerbank with great reverence ; but with regard to the subject before them, he had, from observations of his own, recently had occasion to mention to the Doctor some doubts which he had, whether the sponge *Cliona* did not really possess the perforating powers which had been attributed to it by the old Naturalists. At Lyme Regis, in May last, he had found some spat of oysters and "crows," apparently about a fortnight old ; the shells were very small—not more than $\frac{1}{16}$ to $\frac{1}{8}$ of an inch in diameter—and he saw upon these some small specks, which proved, upon microscopic examination, to be borings, filled with *Cliona*. He was strongly impressed with the idea that these borings were made by the sponges, because he did not believe that there were any Annelids so small as to make such minute holes so rapidly filled with the sponge. He did not believe in *Cliona* having any frictional process of boring by the aid of minute grains of sand, which had been alluded to ; he believed the action to be more probably chemical than mechanical. He had been struck by the appearance of erosion and corrosion in the shells which had been bored, especially when *Cliona* was found—as it frequently was—in an almost continuous flat layer between the laminæ of the shells. He used to think at one time that it was an error to suppose that the borings were made by the sponge, but his more recent observations had led him to conclude that there was at least enough evidence to the

contrary to make him pause before confirming the opinion so strongly expressed by the reader of the paper "that a boring sponge was a creature of the imagination." It might be interesting to mention that the work of destruction upon the shell of the oyster was carried on so rapidly, and to such an extent, that one owner of oyster beds believed he had lost from this cause alone this year at least £400. It was quite correct, that when infested by the sponge the oyster thickens up its shell rapidly from the inside, apparently to keep out the intruder. He regretted that he was not aware that the subject was to have been brought forward, or he would have brought with him to the meeting some specimens in illustration of his remarks.

Mr. Waller pointed out that he had, upon his diagram, represented a portion of a shell, with the holes shown between the laminæ.

Mr. Henry Lee said that the portions of the laminæ to which he had referred were not the same as those drawn—they had the appearance of being eroded, as if acid had been poured upon the part.

Mr. Waller said that Dr. Bowerbank had found a Pecten (?) in a cavity entirely filled with the shell; and Mr. Handcock disbelieved that there was any action of a cutting nature.

Mr. Henry Lee said he was quite of the same opinion.

Mr. Charles Stewart said, that although he was not a member of the Club, he hoped he should not be considered out of order in drawing attention to one particular relating to the *Cliona*, which had not been mentioned by Mr. Waller. This was the way in which it appeared when fully expanded in undisturbed water. He then drew a diagram upon the black board, and explained that when entirely undisturbed the sponge might be seen protruded from the stone or shell as mushroom-shaped elevations, having a superficial resemblance to a Zoanthus, increased by radiating lines on their upper surface. Besides these, which were by far the most numerous, there were a few conical elevations of a larger size, and having a large opening (osculum) on their summits. By a little careful examination, it would be found that the upper surface of these mushroom-shaped processes is the only part perforated by the small pores through which the water passes into the interior of the sponge, as shown by the small particles of mud and other substances which were drawn towards them. He agreed with Mr. Lee in believing that there was evidence in the peculiar character of the perforations in support of the idea that these sponges really did make the holes, although it was not quite clear by what means. Many of the Annelids no doubt secreted an acid, and he had obtained from them an acid re-action upon litmus paper, but there appeared to be no such re-action produced by the *Cliona*.

Mr. Waller asked how they were to account for the perforations in shells such as he had sometimes found, which were so entirely perforated that he could break it up between his fingers?

Mr. Charles Stewart imagined that these must be quite old shells.

Mr. Henry Lee said that the sponge was very readily destroyed by drying, and it had been found by experiments that by laying out the oysters upon the sand, the sponge was destroyed much more easily than the oyster, and this means had been resorted to for getting rid of the sponge.

The President said that he could not pass on to the next business of the meeting without thanking those gentlemen who had so ably referred to the subject before them, and who, in doing so, had contributed so much interesting information. With reference to the means by which the sponge worked, he

thought it was by no means necessary that the organism should be furnished with hard moveable spicules to act mechanically, or with acid or other fluid of a solvent nature. The mere rapid passage of continued currents of fluid would in the course of time wear away the hardest substances. There were many instances of this to be found, such as the absorption of the fang of the temporary tooth during the formation or eruption of the permanent set. These little currents alluded to were, of course, quite microscopic, and the particles removed were so small that they would be quite invisible under the highest powers; they were, nevertheless, not dissolved probably. And when he looked at the appearance of the depressions and holes supposed to be made by these sponges, he thought that they bore a remarkable resemblance to the surface of a portion of a bone, or of a fang of a tooth, which had been partly removed by absorption.

The President announced that, with a view to informing members of the subject of Papers to be read at the meetings of the Club, it had been resolved to announce them by advertisement in "The Echo" newspaper on the Monday evening preceding each meeting.

The President having to leave the meeting, requested Mr. Henry Lee to take the chair in his stead. This having been done,

Mr. Unwin exhibited and explained a new apparatus, which he had designed for cutting thin sections of soft substances. A surgeon's amputating knife was firmly clamped upon a wood block fixed upon a planed wood stand, the upper surface of the block being bevelled in such a way as to admit of the knife being readily set, with its edge either horizontal and parallel with the stand, or inclined towards it at any given angle. The object to be sliced was then fixed by means of set screws in a strong cylindrical brass holder, the height of which could be adjusted with great nicety by a screw thread cut on its outside, and working up from within a solid brass base. The holder, when adjusted, was passed by the hand beneath the knife blade, and in this manner sections of any required thickness could be cut with great precision. The thickness of the slices were regulated by rotating the holder, which could be firmly retained in any required position by means of a back nut.

The Chairman expressed the thanks of the meeting to Mr. Unwin for his communication, observing that though some of the machines in use left little to be desired, he thought the one just exhibited to the meeting might be very usefully employed; a great amount of steadiness was obtained by this method of fixing the object, and it was for many purposes an advantage to have the knife a fixture.

The Secretary exhibited a new and simple form of compressorium, designed by Mr. Locke, consisting of a wood slide, having a small block on one side carrying the arm, from which the required pressure was obtained.

The proceedings then terminated with a *conversazione*, at which the following objects were exhibited:—

Campylodiscus costatus	By Mr. M. Burgess.
Section of Human Brain	Mr. J. Gibson.
Calyx of Deutzia...	Mr. Jackson.
Eye of Earwig	Mr. R. T. Lewis.
Proboscis of Exotic Moth	Mr. S. J. McIntire.
Spirorbis Nautiloides	Mr. Martinelli.
A Simple Erecting Glass	Mr. E. Richards.
Elytron of Goliath Beetle	Mr. Slade.
Also Specimens of *Peziza lanuginosa* for Distribution	Mr. M. C. Cooke.

October 13th, 1871.—Conversational Meeting.

The following objects were exhibited:—

Spores of Uncinula adunca	By Mr. Gumiaraens.
Various Micro-Lepidoptera and Plant Bugs (Tingides)	Mr. Allbon.
Gnat in spider's web, with ova, showing larvæ inside	Mr. Fitch.
Sponge—Dysidea fragilis (polarised)	Mr. J. G. Walker.
Eggs—Pieris brassicæ, *in situ*	Dr. Matthews.
Areolar tissue of Crab (Cancer pagurus) ...	Dr. Matthews.
Sections of Crab Shell	Mr. J. Slade.
Hemiptera—Tingis foliacea	Mr. J. Gibson.
Various Entomological preparations	Mr. Oxley.
Lymnea stagnalis Embryos, in ova-sac (alive), polarised	Mr. Geo. Williams.
Volvox globator (alive)	Mr. Martinelli.
Spores of Equisetum	Dr. Ramsbottom.
Bearded Gnat ... ... / Beetle (Staphylinidæ)	Mr. E. Pattison Pett.
Coaterina Hirundinis	Mr. R. P. Williams.

October 27th, 1871—*Chairman*, Dr. Lionel S. Beale, F.R.S., President.

The following donations to the Club were announced:—

"Land and Water" (weekly)	from the Editor.
"The Monthly Microscopical Journal"	the Publisher.
"Science Gossip"	the Publisher.
"The Popular Science Review"	the Publisher.
"The Journal of the London Institution"... ...	the Librarian.
"The Handbook of British Fungi"	Mr. Quicke.

The thanks of the Club were unanimously voted to the donors.

The following gentlemen were balloted for and unanimously elected members of the Club:—Mr. D. E. Goddard, Mr. Frederick Anthony Parsons, Mr. David John Stuart.

Mr. Rochfort Connor exhibited to the meeting a number of beautifully executed drawings of microscopical objects, also a series of photographs of drawings of vegetable tissues. The original drawings, it was explained, had been made on a larger scale, and with a view to a practical purpose, namely, the detection of adulteration of exciseable commodities.

The President proposed a vote of thanks to Mr. Connor for his kindness in bringing these drawings for the inspection of the members of the Club, and called especial attention to the photographs, which were taken from drawings made on a diagram scale. These photographs could, of course, be easily multiplied, almost indefinitely, and would be of great use for purposes of comparison.

Mr. T. Curties said that some months ago some slides of Marine Polyzoa were

placed in his hands, to be presented to the Club, by Dr. Lattey, of Hastings. As they were mounted in fluid, he thought it best to place them on one side for some little time, to see how they would stand—and now finding them quite right, he had brought them to the meeting for presentation. The objects themselves were, perhaps, no great novelty, but the way in which they had been prepared showed some very interesting features which were not to be met in the ordinary bought slides, and he had, therefore, asked Dr. Lattey to furnish a few notes in description of them. Mr. Curties then proceeded to read Dr. Lattey's paper, and on its conclusion intimated that the specimens alluded to were being exhibited in the room under his own microscope and that of Mr. Brown.

The President said he felt sure that all present would cordially unite in presenting a vote of thanks to Dr. Lattey for his present, and also for his descriptive notes, as well as to Mr. Curties for bringing them and reading them to the meeting.

A vote of thanks was then carried.

Mr. T. C. White read a paper "On the Microscopical Structure of the so-called Nerve of a Tooth," illustrating the subject by a diagram, and by preparations exhibited under microscopes in the room.

The President proposed a vote of thanks to Mr. White—which he was sure would be unanimous—for his very interesting paper. The field which had been opened up to them by Mr. White was a very extensive one, and would well repay the efforts of those who felt disposed to make it their study. There were many points in connection with it, which time had only permitted him to touch upon, but which involved considerations of very great interest. He had also omitted to mention that Mr. White had brought with him for exhibition a very beautiful preparation—perhaps a better one than would be found to exist elsewhere—showing the nerve and the tooth pulp in a remarkably beautiful manner. He had himself never seen so fine a preparation of this object, and desired to call especial attention to it.

A Member inquired of Mr. White whether the substance of the tooth was, during life, being constantly removed and replenished, as was the case with many other tissues of the body?

Mr. White, in reply, said he did not think it was at all possible that it was so, as he was not aware of any organisation in a perfectly formed tooth by which this could be accomplished; no doubt there was a permeation of fluid holding lime in solution into the tubes of the dentine, by which new osseous matter could be deposited, and an endosmotic action took place sometimes, whereby in cases of jaundice the tubes absorbed yellow fluid, and, in death by strangulation, a red fluid; but he did not think it possible that a process of removal and renewal could take place in a human tooth.

The President said that with regard to the very pertinent question which had just been asked, and so cautiously answered, he thought Mr. White might have gone a little farther, for it was quite certain that the tissues of the tooth were not absorbed, although this was not very easily proved in every tooth. The tusk of the elephant would furnish an example. It was properly regarded as only a modified tooth. It was quite certain that the tip and free part of the tusk could not be removed and restored, owing to its great distance from the source of nutriment, as well as the nature of its substance. It had sometimes been found that a bullet had become imbedded at the root of the tusk, and had by growth in the course of time been pushed forward, until it had come nearly to the extremity. Had the tissue been removable, changes would have been ob-

served at the seat of the foreign body. The fact of the non-removal of dentine and enamel was one which seemed to him to tell strongly against the notion of Pangenesis. The tooth structures, he believed, were not at all renewed. The statement, therefore, which was so often met with, "that all the tissues of the body are being constantly removed and renewed," could only be received as true in a very general sense. Really the several tissues differ remarkably in this respect—some being replenished even in the course of a few hours, whilst others remain for seventy or eighty years without undergoing any nutritive changes whatever. It was, however, to be observed, that the enamel of the tooth was not nearly so brittle whilst in connection with the living body as it became after having been removed for many years, and from this circumstance he should conclude that during life even this hard tissue was permeable to a slight extent. So, also, if a tooth was weighed soon after removal, it would be found that its weight was greater then than after being subjected to desiccation in a hot air chamber, proving that the hard tooth structure really contained a little water. He did not think that the tooth was one of those tissues nearly allied to bone, for bone was replenished faster than muscle or nerve and, therefore, it differs from tooth materially in this respect. This was one of the reasons which induced him to think that the tooth was allied to horn or Epithelium rather than to bone, although the point was one freely open to discussion. Another very important subject had been touched upon, and that was the distribution of nerves in the tooth pulp. The specimen which Mr. White exhibited, and to which he had already called the attention of the members, showed the distribution of the nerves in a remarkably perfect manner, and many persons would be surprised to learn that there is no drawing extant which shows their distribution so admirably as it appears in this specimen. German worshippers would, no doubt, blame him for remarking that no one there has yet given an accurate drawing of nerve fibres near their distribution in such tissues as the tooth pulp. Yet such was undoubtedly the case, and in one of the last memoirs on the distribution of nerves—which appeared in the last number of Max Schultz's "Archives"—they might see the nerves drawn as if they were straight, parallel rods, running side by side; but it was quite certain that no one who had actually seen their arrangement in nature would have represented them as in these drawings. Every student knows that although a nerve looks like a piece of fibrous cord composed of parallel fibres, he cannot tear it longitudinally, and the reason is that nerve fibres are arranged in a plexiform manner, that they are continually crossing from one to the other side of the nerve trunk, and that they are never found running in straight parallel lines, even for the distance of the $\frac{1}{100}$ of an inch. Even where there are only two minute fibres less than the $\frac{1}{10000}$ of an inch in diameter together, they pass spirally round one another, and yet this simple fact is not represented in any foreign work with which he was acquainted. They could not possibly exist as they were shewn in these German drawings, and they would inevitably become deranged if they were placed as drawn. If the members would look at Mr. White's specimen, they would see very clearly this beautiful undulating plexiform arrangement. He thought it was most probable that they did end in loops, although, for the reasons named by Mr. White, this had not yet been clearly traced, but it was certain that nerves formed in every part of their course a wonderful plexus. Terminal plexuses would be found in the sheaths of all the hairs and the number of ultimate nerve fibres in such tissues was enormous. It was most surprising to find that whilst many German observers had traced them to end in

terminal fibres, and had drawn them, showing them to be very narrow indeed, their drawings of *bundles* of nerve fibres were always incorrectly given. He was sure that the subject was one which would well repay any members of the club who would take it up. The pulp of the tooth would yet afford an ample field for discovery, and even if there were no new facts to be made out, it was quite certain that there had yet to be made correct drawings.

The President exhibited to the meeting two very small lamps. It was, he said, often of much importance to have the lamp very close to the specimen under examination, and although the reason had not been very clearly explained, yet it was quite certain that in the illumination of certain objects a much better definition was obtained by using the direct rays from the lamp than rays reflected from the mirror upon the object. He had, therefore, with the help of Mr. Swift, arranged some very small lamps, which could be used for this purpose, being so mounted upon their stands as to admit of their being inclined at the proper angle. In this way the lamp flame could be made parallel with the object glass, and at a very short distance from it. Two lamps of this kind were shown, one of which was fitted with a small copper chimney of Fiddian's pattern, and the other with one of Mr. Swift's silver coated glass chimneys, which also answered very well. One lamp was trimmed with common paraffin, the other with benzoline, which had some advantages, inasmuch as it did not soil the fingers, and gave a much whiter light than the paraffin. One practical difficulty arose in the matter, owing to the fact that benzoline was very volatile and apt to explode, but this had been met by making the top of the lamp quite closed, and the body to screw up, so as to increase or reduce the light as required. A small bull's eye, made with a ring to slip over the chimney, greatly increased the power of the light, and the lamps could themselves be produced at quite a small cost. He had found it an immense convenience to have the lamp so small as to be readily moved about. Though so small, they contained enough spirit to burn for two or three hours, which he thought was quite as long as anyone would desire—certainly it was as long as anyone ought to work continuously at the microscope.

The Secretary announced that he had received communications from the South London Microscopical and Natural History Society, the Croydon Microscopical Society, and the Islington Natural History Society, inviting the co-operation of members of the Quekett Club at their forthcoming soirées; also a letter from Mr. Henry Walker, Secretary of the Early Closing Association, calling attention to the fact that prizes had recently been offered for essays, to be competed for by members of Microscopical and Field Clubs, and giving information as to the terms and conditions.

The proceedings then terminated with a *conversazione*, at which the following objects were exhibited:—

Marine Polyzoa	By Mr. W. J. Brown.
Bugula Avicularia	Mr. T. Curties.
Pistil of Jalapa Mirabilis	Mr. De Guimaraens.
Male Organs of Wasp ... ... Cinnabar imbedded in Chalcedony ...	Mr. Fitch.
Foraminifera from Chalk	Mr. Hopkinson.
Male Cochineal Insects	Mr. R. T. Lewis.
Electric Spark discharged between Graphite Terminals	Mr. Martinelli.
Wing of Hornet, shewing hooks	Mr. Oxley.

Circulation in Tradescantia, shown with $\frac{1}{40}$ inch objective and patent Binocular	Mr. Thos. Powell.
Sections of Teeth of Mastodon and Megatherium	Mr. Slade.
Skin of Dog Fish	Mr. J. G. Waller.
Odontoblasts projecting from Pulp of Tooth Various preparations of Pulps of Teeth	Mr. T. C. White.
Floscularia, alive	Mr. G. Williams.

Attendance—Members, 144; Visitors, 11.

November 10th, 1871.—Conversational Meeting.

The following objects were exhibited :—

Corals ... ... by	Mr. Golding.
Fossil Nummulite and Zoophytes	Mr. E. Swain.
Photograph in Beetle's Eye	Mr. J. F. Gibson.
Uncinula adunca	Mr. Jackson.
Proboscis of Tyrphus	Mr. Ward.
Section of Kidney (transparent)	Dr. Matthews.
Pond Life	Dr. Ramsbottom.
Foramanifera in hollow of Flint (found when the flint was broken)	Mr. Fitch.
"Water devil" (polarised)	Mr. J. A. Smith.

Attendance—Members, 44; Visitors, 4.

November 24th, 1871.—*Chairman*, Dr. Lionel S. Beale, F.R.S., President.

The following donations to the Club were announced :—

"Land and Water" (two numbers)	from the Editor.
"The Monthly Microscopical Journal"	the Publisher.
"Science Gossip"	the Publisher.
"Proceedings of the Royal Society"	the Society.
"The American Naturalist," Sept. and Oct. ...	in exchange.
"Annual Report and Abstract of Proceedings of the Brighton and Sussex Natural History Society"	the Society.
"Proceedings of the Bristol Naturalists' Society"	the Society.
"Journal of the London Institution"	the Librarian.
A Zoophyte Trough	Mr. Meacher.

The thanks of the Club were voted to the donors.

The following gentlemen were balloted for, and unanimously elected members of the Club :—Dr. Charles Hawker, M.R.C.S., Mr. Charles Hurdle, Mr. T. Preston Lewis, Mr. Frederick Pitts.

Mr. M. C. Cooke read a paper upon Tremelloid Uredines (Podisoma), which he illustrated by coloured diagrams and dried specimens.

The President moved a vote of thanks to Mr. Cooke for his highly interesting paper, which was carried unanimously. He also said he should be glad to hear from Mr. Cooke what were his own views upon the subject of the alternation of generations to which he had so forcibly directed their attention.

Mr. Cooke, in response to the President's request, said that there was no doubt of the alternation of generations in some fungi—as, for instance, the bunt, where all were passed in the same host. But he felt great difficulty in accepting such conclusions as those of Professor Oersted, where the generations were passed in different plants, until confirmed by other observers. If the spores of *Æcidium Berberidis* were taken from the Barberry and sown upon young wheat plants, and all these plants became infected with corn mildew *(Puccinia graminis)*, to which wheat is but too prone, it certainly seemed premature to say that the spores of the *Æcidium* caused the *Puccinia* to be developed as a second generation; whereas it is much more probable that the germs of the mildew already lay dormant in the wheat, and, at most, the sowing and growing of the *Æcidium* spores only stimulated the mildew to a more rapid development. He certainly thought such a theory more probable, and quite as sound as the other.

Mr. W. T. Suffolk said that it would be remembered that some time ago (January 22nd, 1869) he made some observations upon the delineation of microscopic objects. An accidental visit to a stationer's shop had supplied him with a material for this purpose, which he thought was likely to prove very useful. He was generally too idle to trouble to turn the microscope down so as to use the camera lucida, but was in the habit of using a ruled diaphragm, placed in the eyepiece, and then drawing the object upon paper ruled in squares; but there was sometimes a little difficulty in ruling paper accurately, especially when the squares were required to be small. At "Letts's," a short time ago, however, he found that they kept in stock paper ruled in this way quite accurately—and that there were thirteen sizes of it to be had, ranging from 1 inch squares down to 13 squares to the inch, specimens of which he had brought with him to the meeting. The advantages of this method of drawing were that it did not necessitate the disturbance of any part of the apparatus, and it did not fatigue the eye as the camera lucida did.

Mr. James Smith inquired if there was any definite size assigned to these ruled squares, so as to enable anyone to indicate the size of the objects themselves?

Mr. Suffolk, in reply, said that it was only necessary to measure the value of a space with the micrometer, and the ruling would then become at once available for the purpose of measurement.

The President proposed a vote of thanks to Mr. Suffolk for his communication.

The Secretary called attention to a new lamp-stand, designed by Mr. Richards, for mounting the President's small lamps. It consisted of a ring foot, with an upright rod screwed into it, upon which the mounting of the lamp was made to slide, a set screw securing it at any height required. He thought, however, that it would have been much more useful had it been provided with a universal joint, so as to enable the lamp to be inclined at any required angle.

Dr. Matthews also introduced to the notice of members another form of stand adapted for the same lamps, in which a universal movement was secured by means of a ball and socket joint in the centre of the foot. A very useful addition to the lamp was also exhibited, consisting of a tube, which could be screwed in the place of the bull's-eye condenser in front of the open space in

the chimney, the condenser being then screwed to the end of the tube. This at once made the lamp available for the illumination of opaque objects.

Letters from Mr. W. Hainworth and Mr. Waller were read to the meeting by the Secretary, and the proceedings terminated with a *conversazione*, at which the following objects were exhibited :—

Fossil Sponge	by Mr. Fitch.
Various Foraminifera	Mr. Hailes.
Pigment Cells of Human Eye	Mr. R. T. Lewis.
Plate of Pipe Fish (Syngnathus Acus)	Mr. Pett.
Polyzoa from Bermuda	Mr. Sigsworth.
Larva of Day Fly	Mr. J. A. Smith.
Poison Bag of Spider	Mr. Ward.

Attendance—Members, 97 ; visitors, 8.

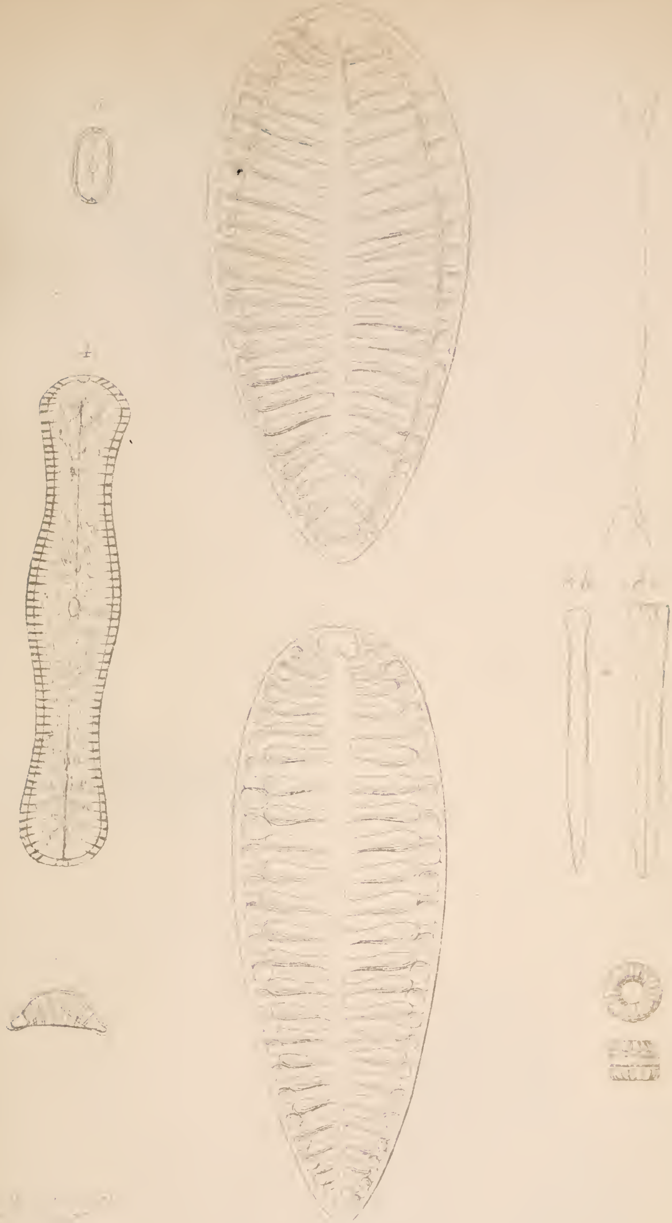
R. T. Lewis.

CATALOGUES.

The Committee of the Q. M. C. with pleasure announce that they have prepared and printed Catalogues of the Books in the Library, and the Microscopical Preparations in the Cabinet. The latter exceeding in bulk one of the numbers of this Journal, it has been resolved that a price shall be charged for copies which shall reduce the cost to the Club. It is believed that Members will prefer this, rather than that the whole amount should be paid out of the Funds of the Club. Announcement of price will be made at the next General Meeting, when copies may be obtained, or by enclosing the amount in postage stamps to the Secretary, 32, Belgrave Road, S.W.

PLATES

CONTAINED IN THIS VOLUME.



Norman Diatoms

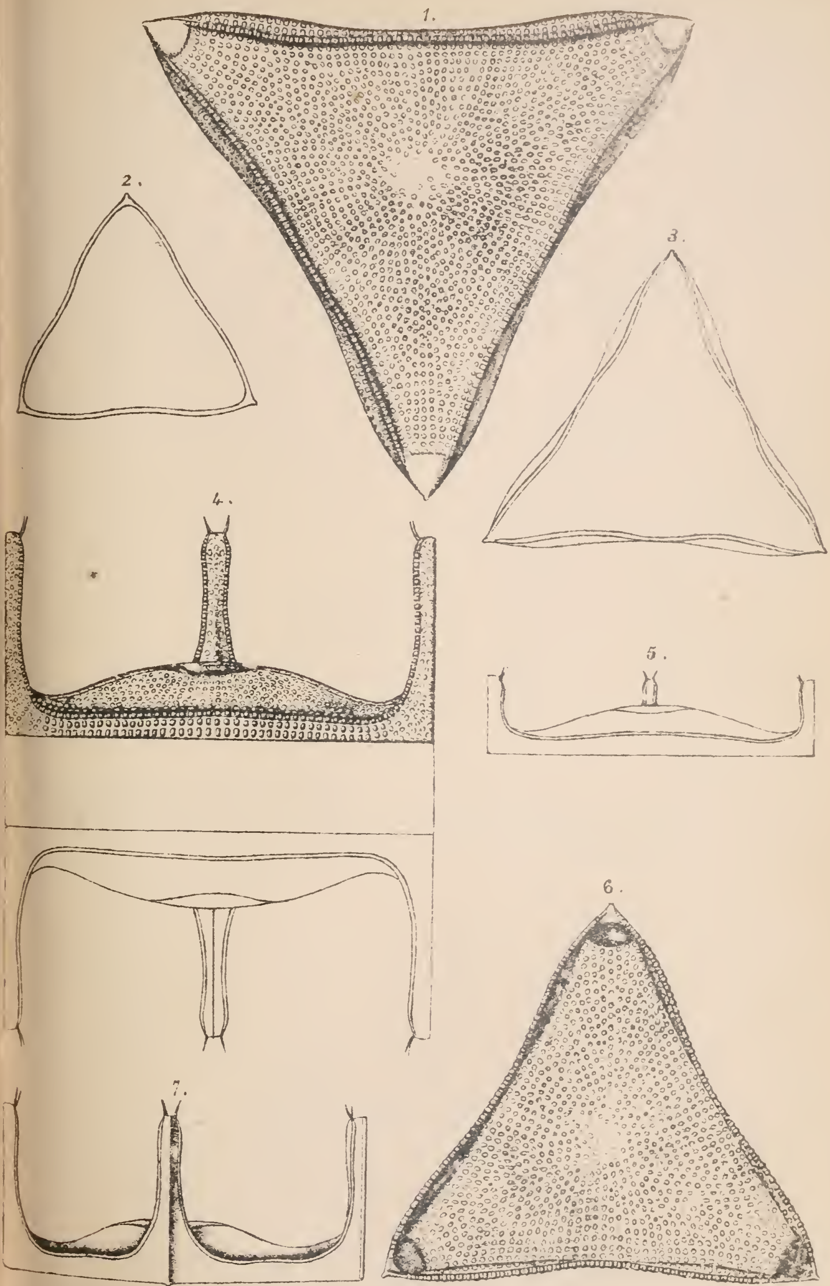


Photo-Chromo Lith.
4, Tooks Court

Trinacria Regina.

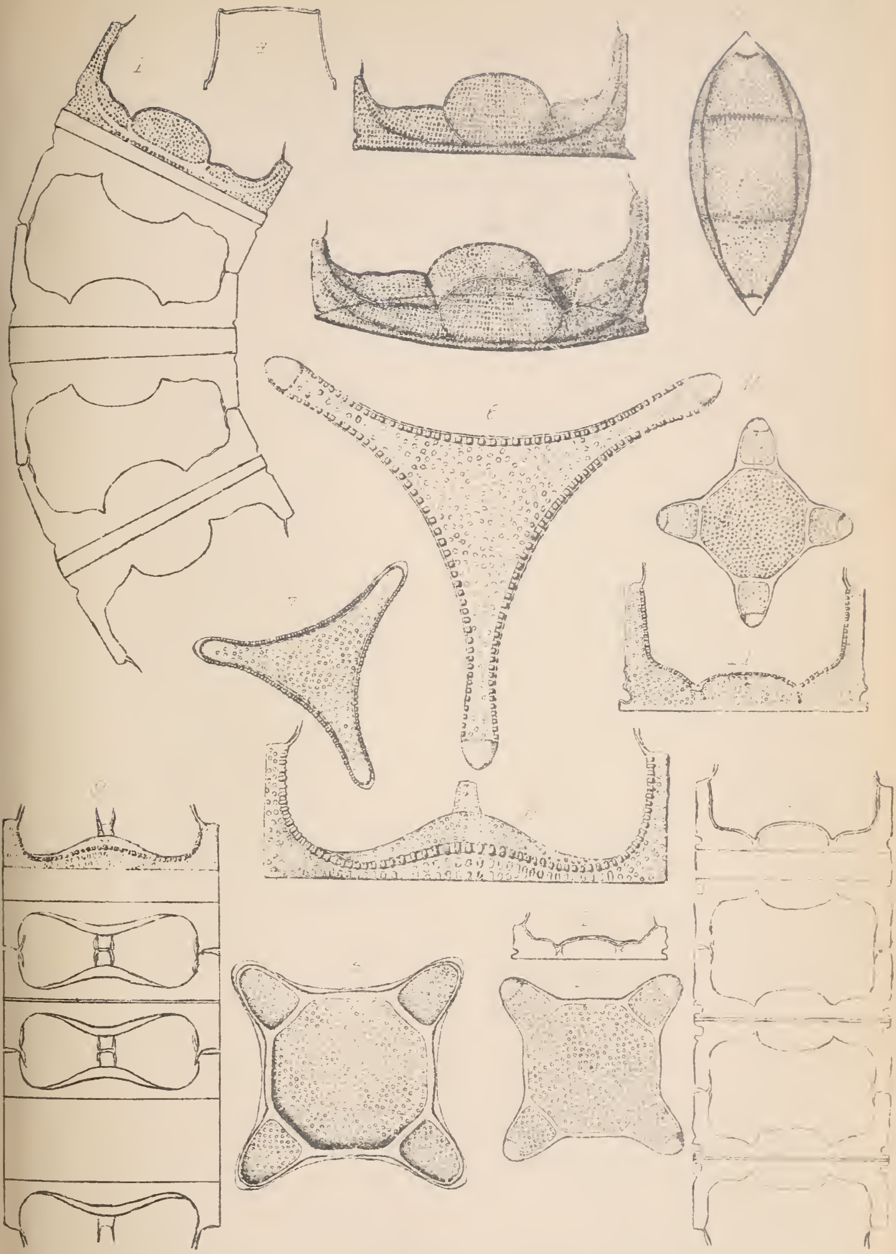


Photo-Chr. mo Lith.
4. Tooke Court.

1_5. Corinna elegans.

6_9. Trinacria excavata.

10_15. Solium exsculptum.

Dactylium dendroides.

a.

Photo-Chromo Lith.
4, Tooks Court.

Dendryphium fumosum.

Photo-Chromo Lith.
4, Tooks Court.

Polyactis fasciculata.

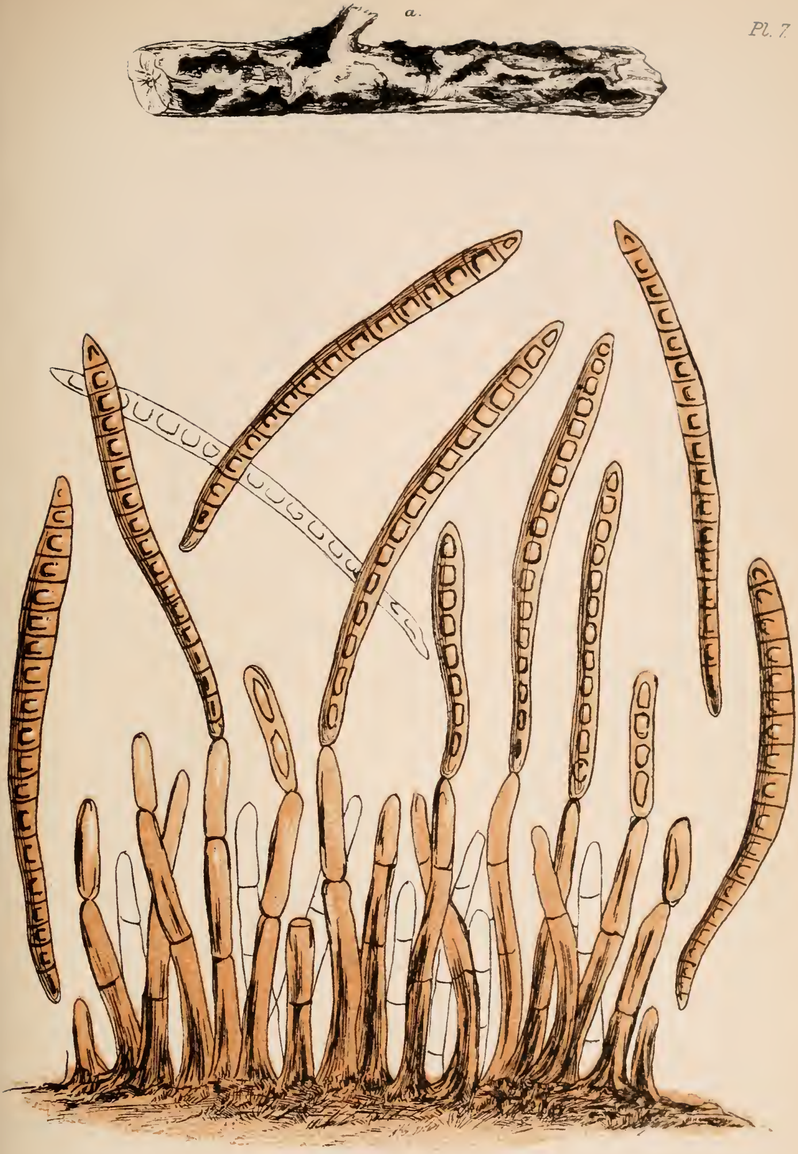


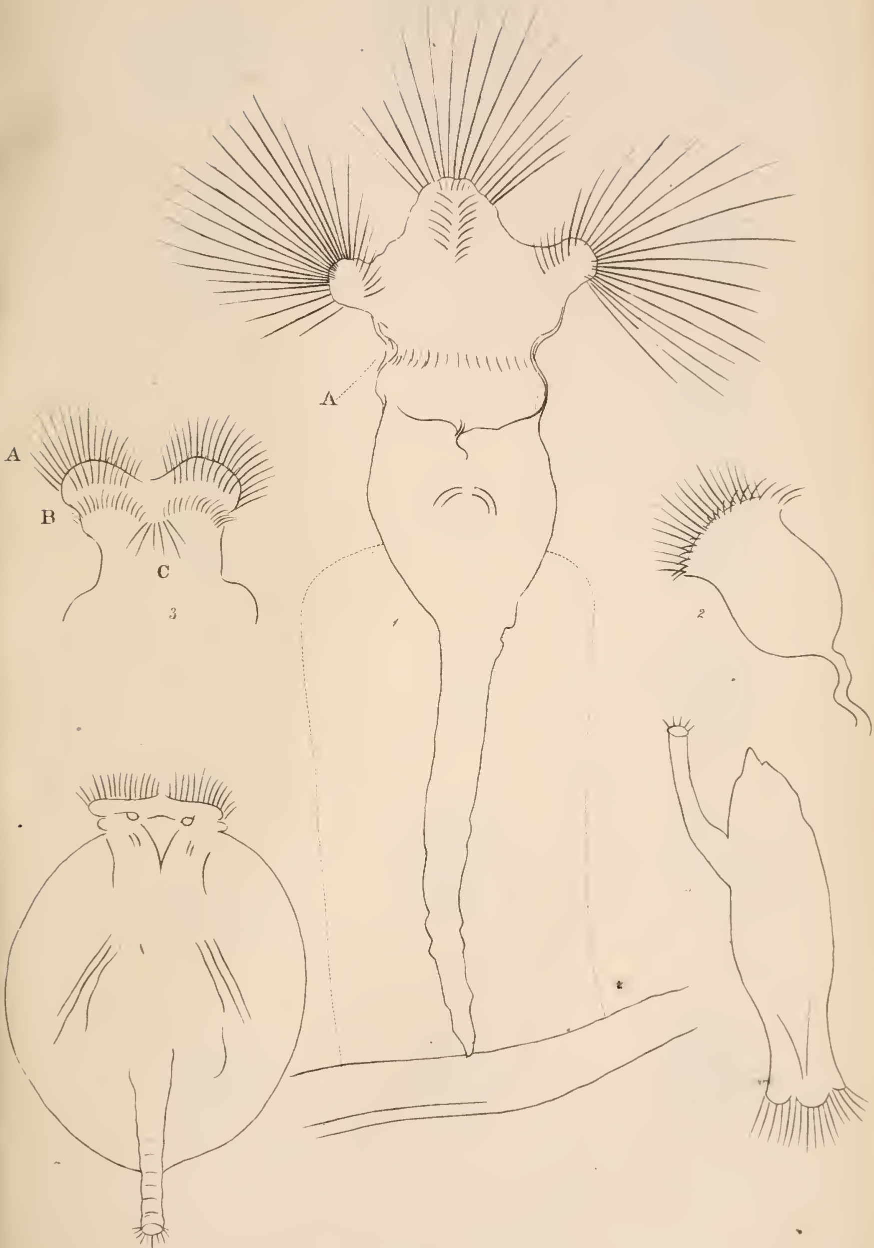
Photo-Chromo Lith.
4. Tooke Court.

Helminthosporium Smithii B. & Br.

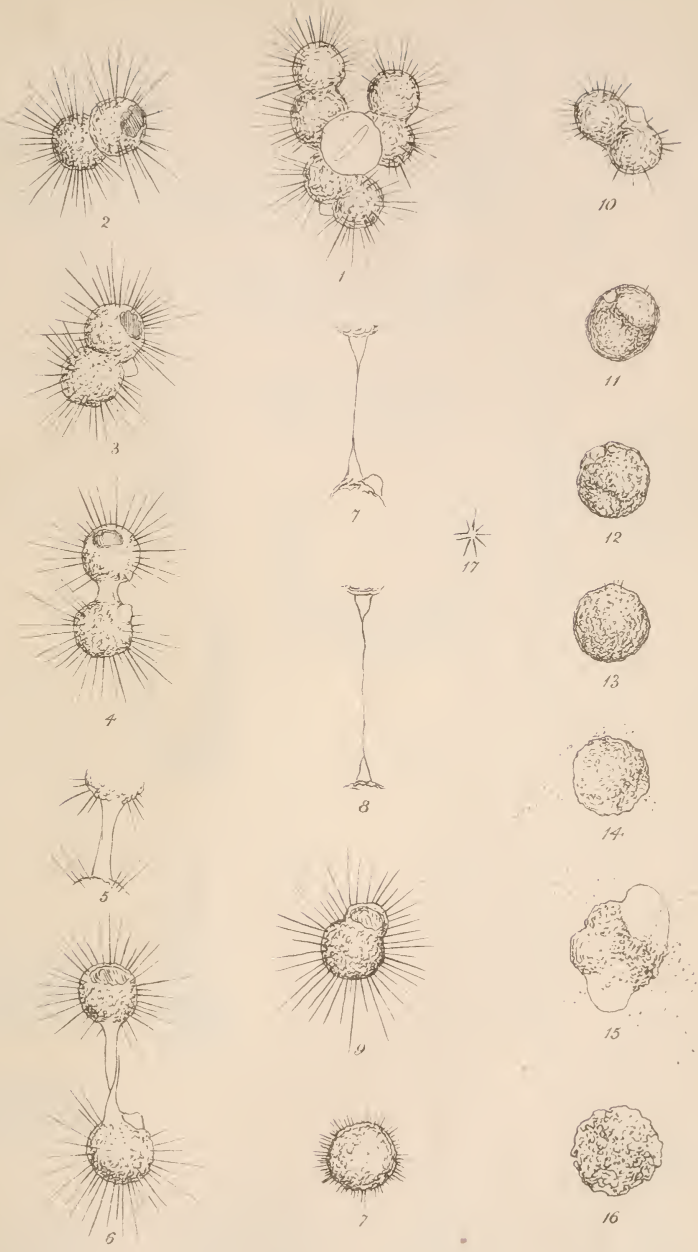
a.

Photo-Chromo Lith.
4, Tooks Court.

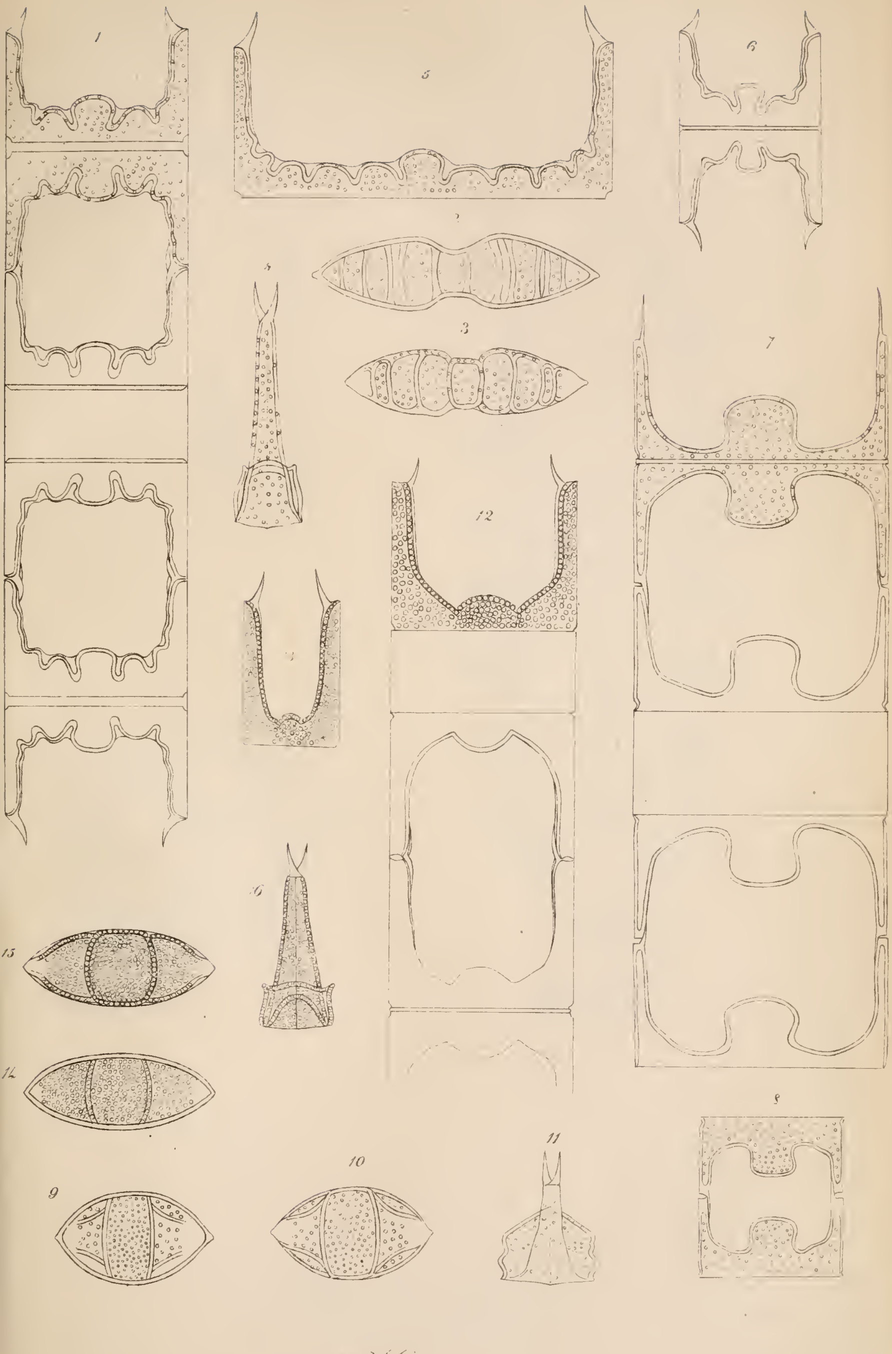
Triposporium elegans.



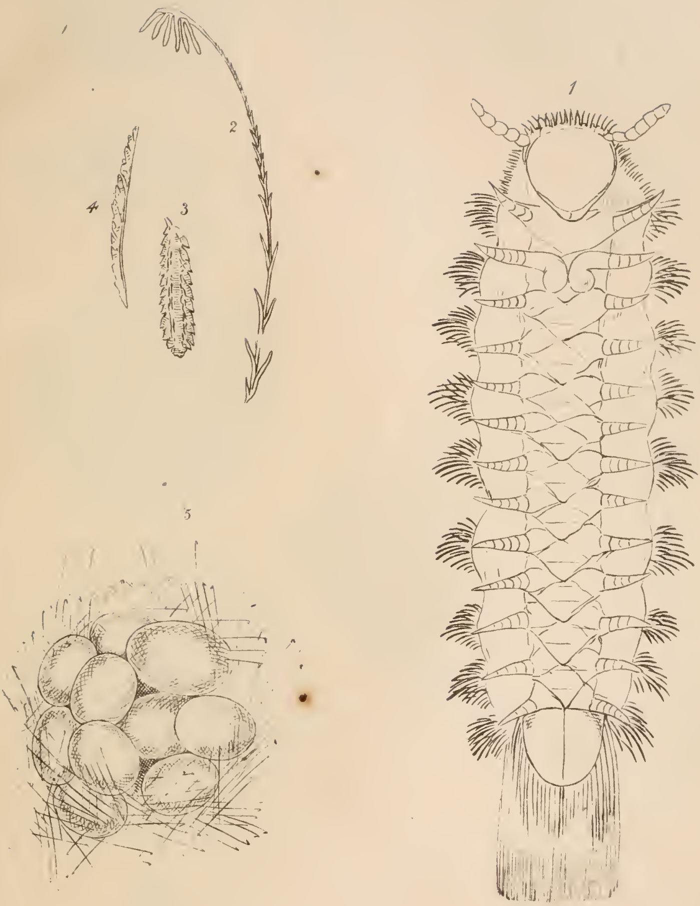
Floscularia



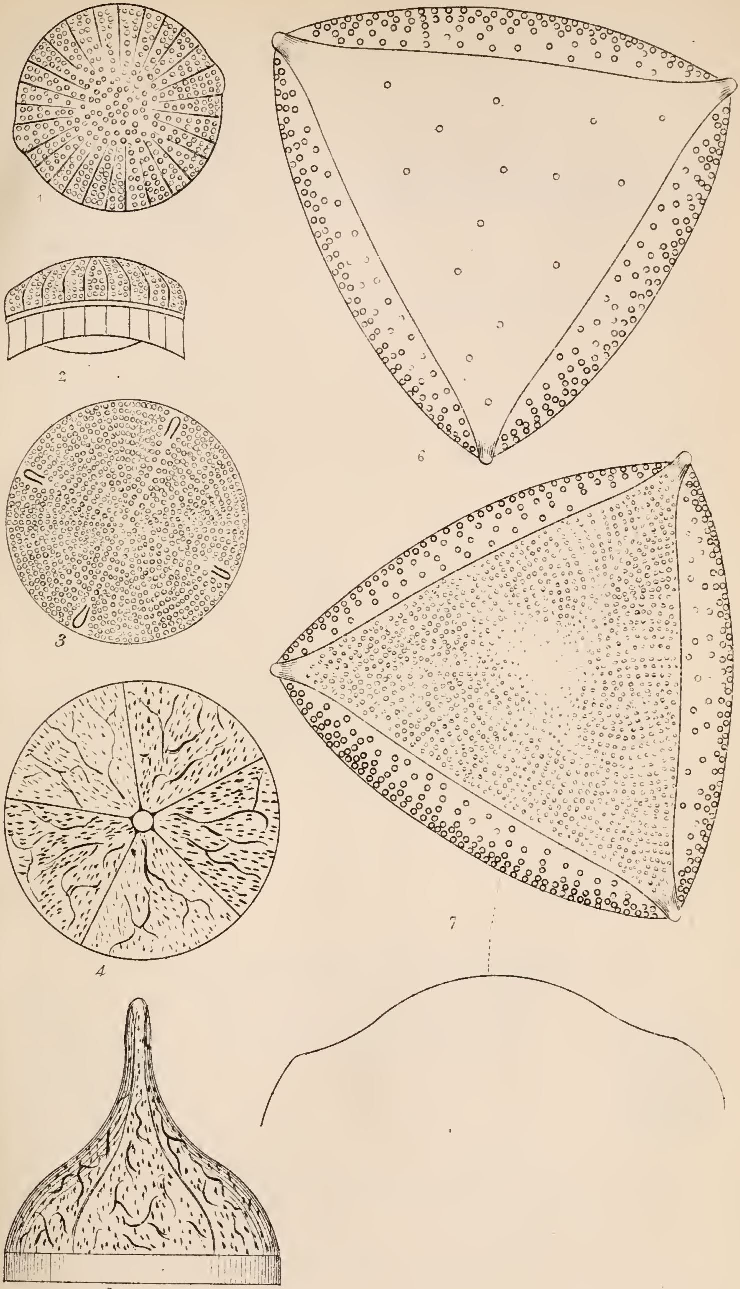
Actinophrys



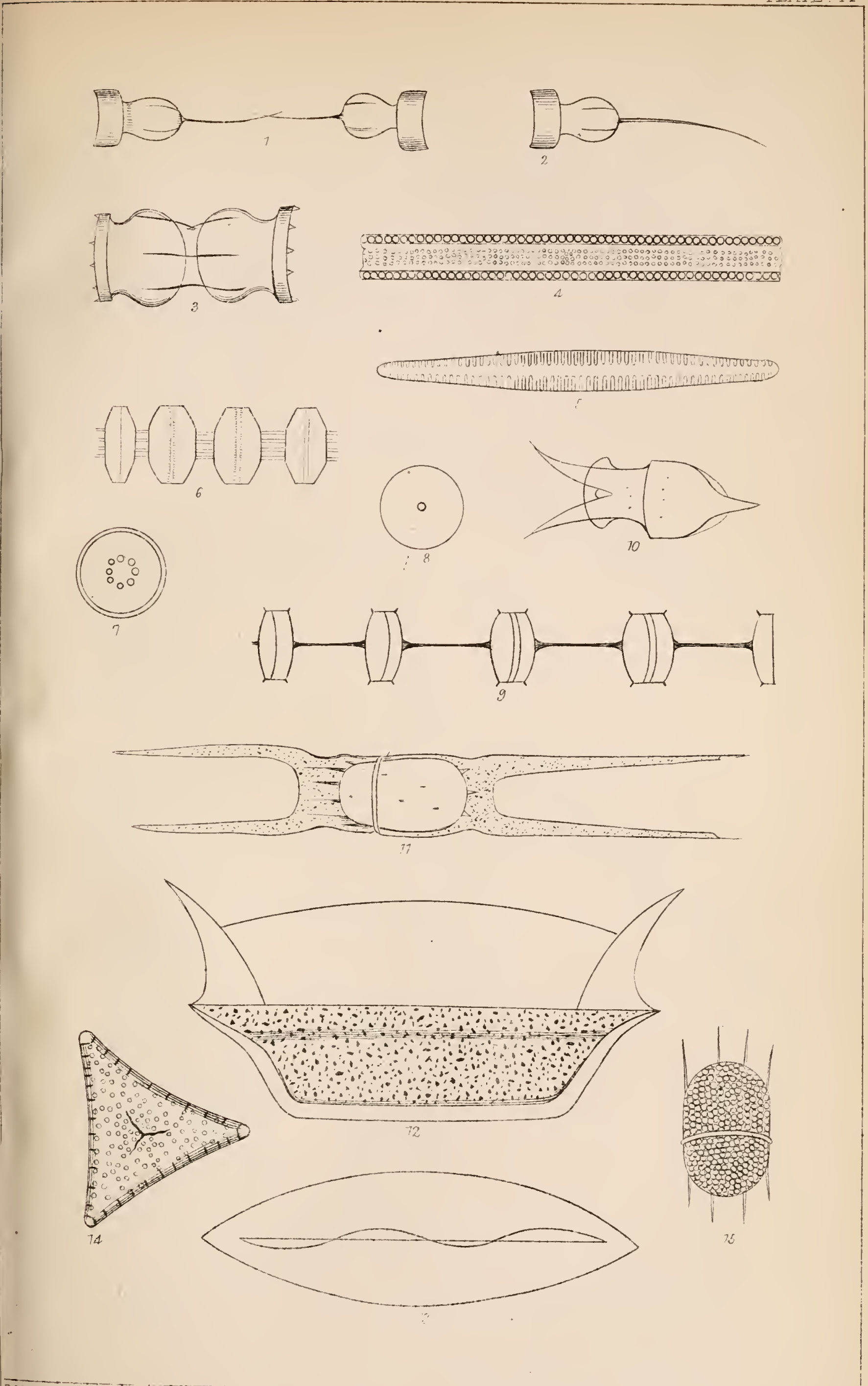
Hemiaulus



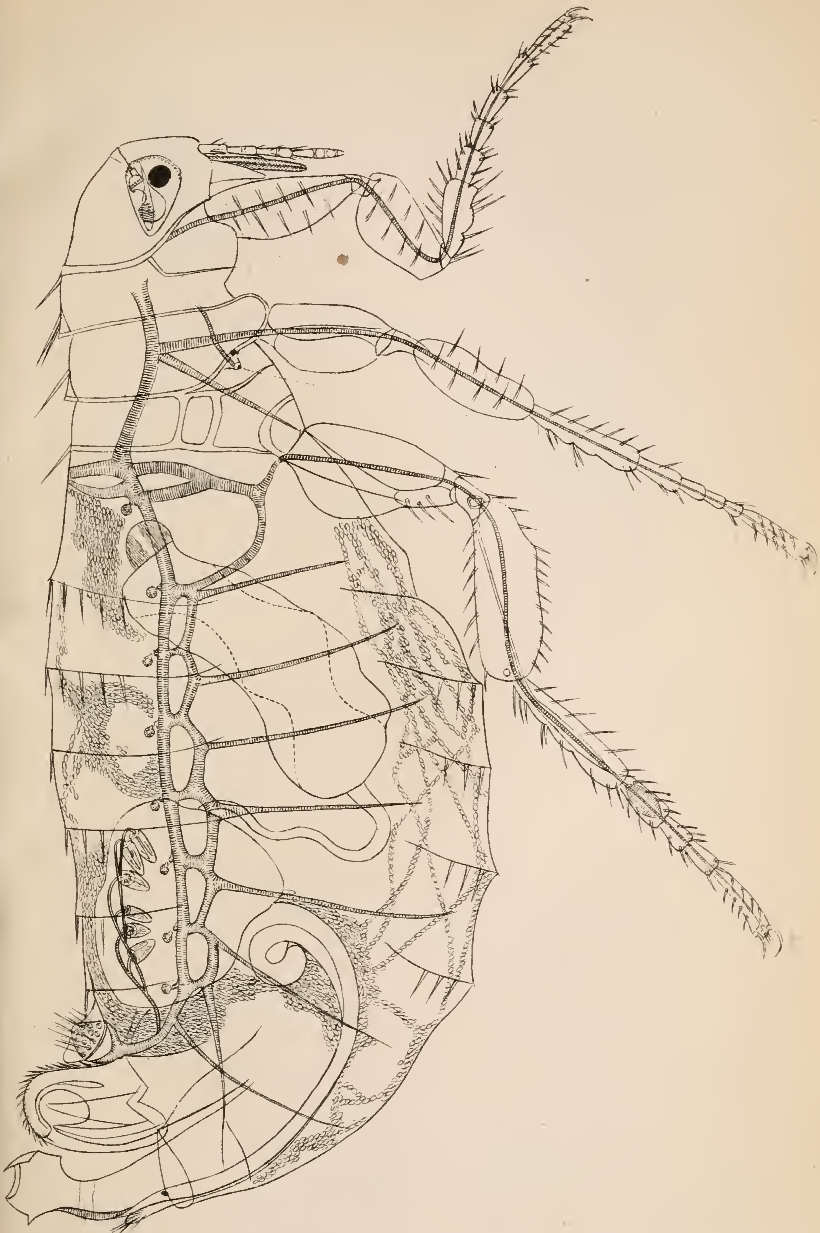
Polyxenus Lacurus
ventral surface.



F Kitton. del



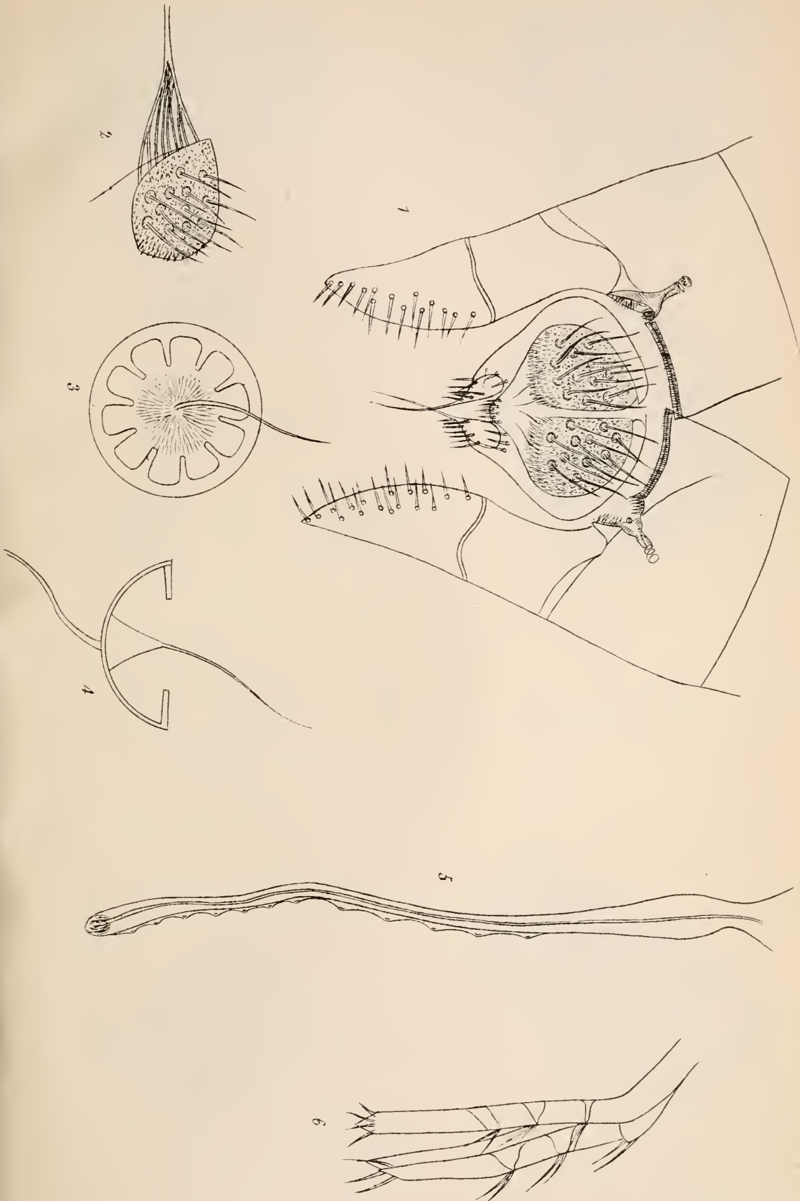
T. Kitton del. E. Cooke lith.



Cooke, lith

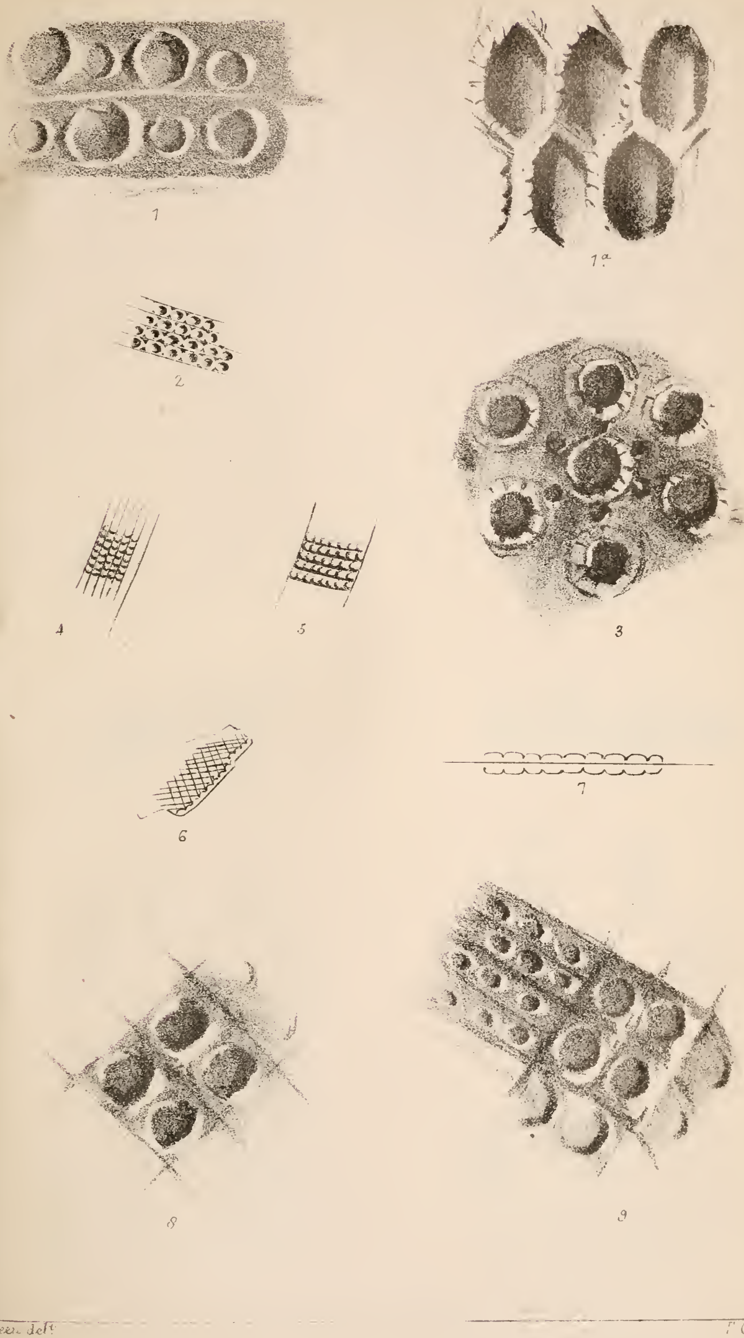
1 Wayimp

PLATE 16



E Cooke lith.

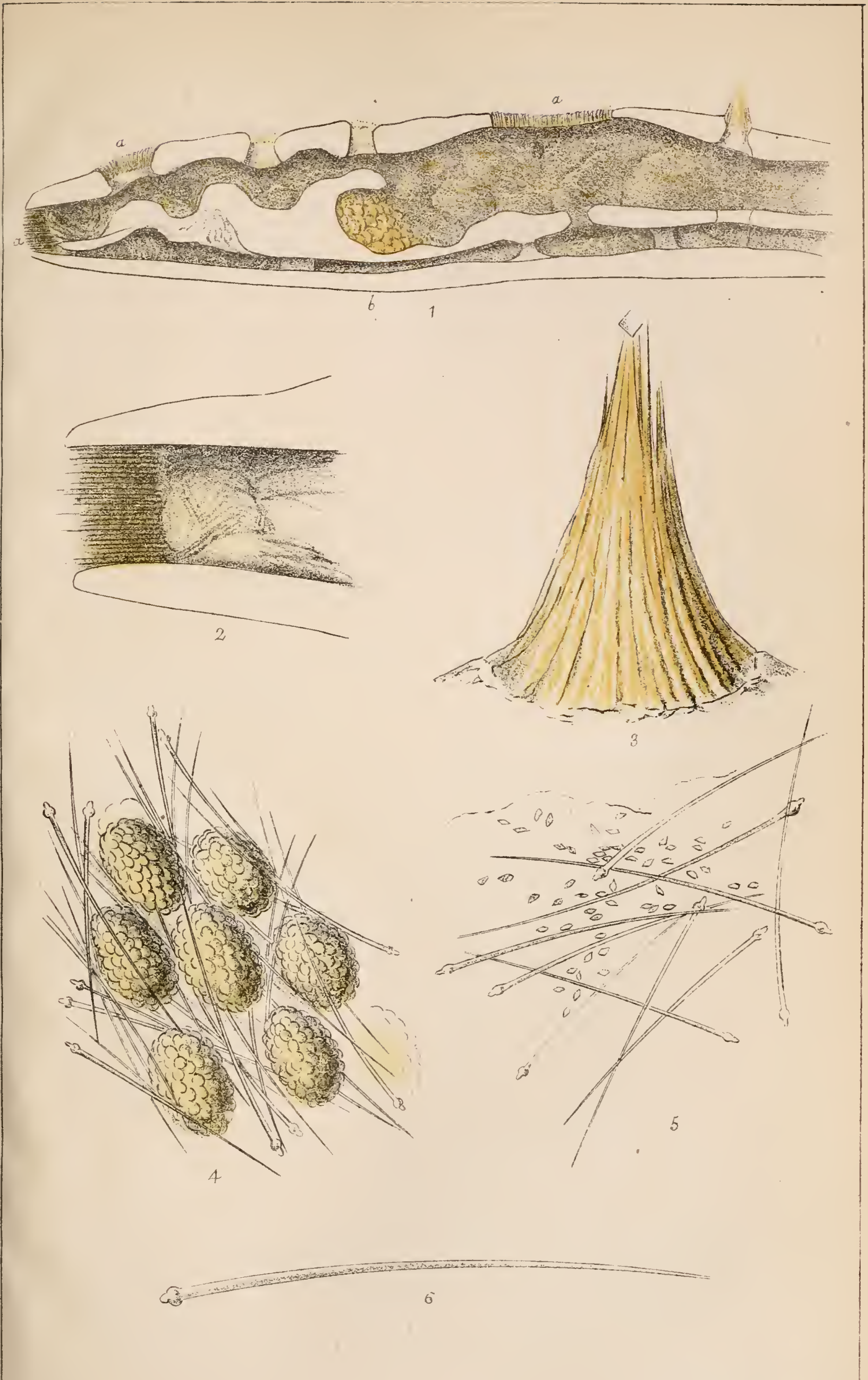
T Way imp



N.E. Green del.t T. Cooke lith.

M.C.C. del.

E. Cooke lith.



E. Cooke lith.

INDEX.

CATALOGUE

OF THE

BOOKS IN THE LIBRARY

OF THE

Quekett Microscopical Club.

CATALOGUE.

Note.—*The Books marked * do not circulate.*

Adams (George). Essays on the Microscope . . 1798
Allder (J.) and Hancock (A.) A Monograph of the British Nudibranchiate Mollusca. 7 parts (Ray Society) 1845-55
*Allman (G. J.) A Monograph of the Gymnoblastic, or Tubularian Hydroids. Part I. (Ray Society) 1871
Annals of Natural History, or Magazine of Zoology, Botany, and Geology. 20 vols. . . . 1838-47
Ditto Ditto 2nd series. 20 vols. . . . 1848-57
Baker (Henry). Of Microscopes and the Discoveries made thereby. 2 vols. 1785
—————— The Miscroscope made easy . . 1742
Beale (Dr. L.) How to Work with the Microscope . 1857
—————— Ditto 1867
—————— Ditto 1868
—————— The Microscope and its Application to Clinical Medicine 1854
—————— Kidney Diseases, Urinary Deposits, and Calculous Disorders, their Nature and Treatment 1869
—————— Illustrations of the Salts of the Urine, Urinary Deposits, and Calculi . . . 1869
—————— Protoplasm 1870
—————— Structure and Growth of the Tissues . 1865
—————— Disease Germs, their Supposed Nature 1870
—————— Disease Germs, their Real Nature . 1870
Beck (Richard). A Treatise on the Construction, Proper Use, and Capabilities of Smith, Beck, and Beck's Achromatic Miscroscopes . . . 1865

Blackwall (John). A History of Spiders of Great Britain and Ireland (Ray Society) 1861
Bowerbank (J. S.) A Monograph of the British Spongiadæ (Ray Society). 2 vols. . . 1864
Brewster (Sir David). A Treatise on the Miscroscope 1837
*Bury (Mrs.) Polycystins: Figures of Remarkable Forms, &c. in the Barbadoes Chalk Deposit. Edited by M. C. Cooke. 2nd edition.
Carpenter (Dr. W. B.) The Microscope and its Revelations 1856
——— Ditto 1857
——— Principles of Human Physiology. 1846
——— Vegetable Physiology . . 1865
——— Introduction to the Study of the Foraminifera (Ray Society) 1862
Catlow (Agnes). Drops of Water 1851
Charbrier (J.) See Serres.
Colombo (Michael). Mikroskopische Beobachlungen Von Polypen Des Süssen Wassers . . . 1793
Cooke (M. C.) A Manual of Botanic Terms . . 1862
——— A Plain and Easy Account of British Fungi 1862
——— An Introduction to the Study of Microscopic Fungi 1865
——— A Manual of Structural Botany . . 1865
——— Our Reptiles 1865
——— A Fern Book for Everybody . . 1867
——— Handbook of the British Fungi. 2 vols. 3 copies 1870
Cooke (Rev. T. F.) Authorship of the Practical Electric Telegraph of Great Britain, or the Brunel Award vindicated 1868
Denny (Henry). Monographia Anoplurorum Britanniæ 1842
Dick (Thos.) The Telescope and Microscope
Eley (Henry). Geology in the Garden . . . 1859
Fox (Dr. Tilbury). Skin Diseases of Parasitic Origin 1863
Fonvielle (W. de). Les Merveilles du Monde Invisible 1867
Gibson (Thomas). Land and Fresh Water Shells of Great Britain 1869

Goeze (J. A. E.) Des Herrn Trembley Abhandlungen zur Geschichte einer Polypenart des sussen wassers mit hornerformigen armen aus dem Franzosischen ubersetzt und mit einigen Zusatzen herausgegeben . Quedlinburg, 1775

Goring (C. R.) and Pritchard (A.) Microscopic Illustrations of a few new, popular, and diverting living objects 1830

——— Micrographia 1837

*Griffith (S. W.) and Henfrey (Arthur). Micrographic Dictionary 1860

Griffith (Wm.) Notulæ ad Plantas Asiaticas :—Part II. On the higher Cryptogamous Plants. Arranged by J. McClelland 1849

——— Icones Plantarum Asiaticarum : Part II. On the higher Cryptogamous Plants. Arranged by J. McClelland 1849

Griffith (J. W.) Elementary Text Book of the Microscope 1864

Hannover (A.) On the Construction and Use of the Microscope 1853

Harting (J. E.) Catalogue for Collectors in Natural History 1867

Henfrey (Arthur). Outlines of Structural and Physiological Botany 1847

Hofmeister (Dr. W.) On the Germination, Development and Fructification of the higher Cryptogamia, and on the Fructification of the Coniferæ 1862

Hogg (Jabez). The History, Construction, and Application of the Microscope 1854

——— Ditto 1856

——— Ditto 1867

Huxley (T. H.) Oceanic Hydrozoa (Ray Society) . 1858

——— An Introduction to the Classification of Animals 1869

Ingpen (R.) Instructions for Collecting Insects, &c. . 1843

Janson (E. W.) British Beetles 1863

Johnstone (George). History of the British Zoophytes. 2 vols. 1847

Journals. The Microscopical Journal and Structural Record 1841-2
——— Transactions of the Microscopical Society of London. 3 vols. 1844-52
——— Quarterly Journal of Microscopical Science. 8 vols. 1853-60
——— Ditto, New Series. 7 vols. . . . 1861-7
——— Monthly Microscopical Journal. 3 vols. . 1869-71
——— Quekett Microscopical Journal and Reports. 2 vols. 1866-71
Kolliker. Manual of Human Microscopic Anatomy . 1860
Leeuwenhoek (Ant.) Arcana Naturæ Detecta. 2 vols. 1695-1708
——— Epistolæ ad Societatem Regiam Anglicam et alios illustres viros seu continuatio mirandorum Arcanorum Naturæ detectorum 1719
——— Select Works of, containing his Microscopical Discoveries. Translated by Samuel Hoole 1800
Lowne (B. T.) The Anatomy and Physiology of the Blow Fly. 2 copies 1870
Memoirs of the Literary and Philosophical Society of Manchester. 2nd series 1865-8
Micrographia Restaurata 1745
Muller (O. F.) Von Wurmern des Sussen und Salzigen Wassers mit Kupfern . Copenhagen, 1771
Naturalist (The). 3 vols.. 1865-7
Naturalists' Note Book 1857
Nave (J.) A Handy Book to the Collection and Preparation of Fresh-Water and Marine Algæ, Diatoms, Desmids, Fungi, Lichens, Mosses, &c. 1867
Nicholson (H. A.) A Manual of Zoology . . . 1870
Popular Science Review. 10 vols. 1862-71
Pritchard (A.) A History of Infusoria, Living and Fossil 1842
——— A History of Infusorial Animalcules, Living and Fossil 1852
——— A History of Infusoria, including the Desmidiaceæ and Diatomaceæ, British and Foreign 1861

QUARITCH (B.) Catalogue of Books offered for Sale by him 1868

QUEKETT (J). A Practical Treatise on the Use of the Microscope 1848

——————— Lectures on Histology 1852

RALFS (JOHN). British Desmidieæ 1848

ROBIN (CH.) Du Microscope et des Injections dans leur Application à l'Anatomie et à la Pathologie 1849

ROPER (F. C. S.) Catalogue of Works on the Microscope and of those referring to Microscopical Subjects in his Library 1865

ROYAL SOCIETY OF LONDON, Proceedings of, for 1870-1, vol. xix. 1871

SCIENCE GOSSIP. 6 vols. 1866-71

SERRES (MARCEL DE) AND CHARBRIER (J.) Observations sur les usages du vaisseau dorsal ou sur l'influence que le cœur exerce dans l'organisation des animaux articulés, &c., par M. le Chevlier Marcel de Serres. Essai sur le Vol des Insectes, par J. Charbrier. . . 1813-20

SCHWANN AND SCHLEIDEN'S Microscopical Researches into the Accordance in the Structure and Growth of Animals and Plants 1847

SEAWEEDS, BRITISH, Synopsis of, compiled from Professor Harvey's Phycologia Britannica 1857

SMITH (REV. W.) Synopsis of the British Diatomaceœ. 1853

SMITHSONIAN Institute Reports. 2 vols. 1868-9

SOMERVILLE (MARY) Molecular and Microscopic Science. 2 vols. 1869

SUFFOLK (W. T.) Microscopical Manipulation . . 1870

TREMBLEY (A.) Mémoires pour servir à l'Histoire d'un genre de Polypes d'eau douce 1744

TYNESIDE. Naturalist Field Club Transactions . . 1867

WALKER (HENRY). Saturday Afternoon Rambles Round London 1871

WILLIAMSON (W. C.) On the Recent Foraminifera of Great Britain (Ray Society) 1857

E. JAQUES,
ALPHEUS SMITH,
Honorary Librarians.

Dec. 1871.

FIFTH REPORT

OF THE

QUEKETT MICROSCOPICAL CLUB,

AND

LIST OF MEMBERS.

Meeting at University College, London, on the Second and Fourth Fridays of every Month at Eight o'clock.

Offices: 192, PICCADILLY,
LONDON.

July 1870.

(*Extract from original Prospectus, July* 1865.)

" The want of such a Club as the present has long been felt, wherein " Microscopists and students with kindred tastes might meet at stated periods " to hold cheerful converse with each other, exhibit and exchange specimens, " read papers on topics of interest, discuss doubtful points, compare notes of " progress, and gossip over those special subjects in which they are more or " less interested: where, in fact, each member would be solicited to bring his " own individual experience, be it ever so small, and cast it into the treasury " for the general good. Such are some of the objects which the present Club " seeks to attain. In addition thereto it hopes to organize occasional Field " Excursions, at proper seasons, for the collection of living specimens, to " acquire a Library of such books of reference as will be most useful to " enquiring students; and, trusting to the proverbial liberality of Micro- " scopists, to add thereto a comprehensive Cabinet of Objects. By these, and " similar means, the Quekett Microscopical Club seeks to merit the support " of all earnest men who may be devoted to such pursuits; and, by fostering " and encouraging a love for Microscopical studies, to deserve the approval " of men of science and more learned societies."

OFFICERS AND COMMITTEE.

(Elected July 1870.)

President.

Professor LIONEL S. BEALE, M.B., F.R.S., F.R.M.S.

Vice-Presidents.

Robert Braithwaite, M.D., F.L.S., F.R.M.S.
Arthur E. Durham, F.R.C.S., F.R.M.S.
Peter Le Neve Foster, M.A., F.R.M.S.
Henry Lee, F.L.S., F.R.M.S.

Treasurer.

Robert Hardwicke, F.L.S.

Hon. Secretary.

T. Charters White, M.R.C.S., F.R.M.S.

Hon. Secretary for Foreign Correspondence.

M. C. Cooke.

Committee.

W. J. Gray, M.D., F.R.M.S.
R. T. Lewis, F.R.M.S.
J. Bockett, F.R.M.S.
T. Ketteringham.
S. J. McIntire, F.R.M.S.
B. T. Lowne, M.R.C.S.
T. Crook, F.R.M.S.
J. Matthews, M.D.
W. Allbon, F.R.M.S.
T. W. Burr, F.R.A.S.
W. M. Bywater, F.R.M.S.
Charles F. White, F.R.M.S.

Librarian.

Edward Jaques, F.R.M.S.

Curator.

G. W. Ruffle.

Excursion Committee.

W. J. de L. Arnold.
F. W. Gay, F.R.M.S.
W. W. Reeves, F.R.M.S.
W. T. Suffolk, F.R.M.S.

Exchange (of Slides) Committee.

J. Bockett.
H. F. Hailes.
W. Hislop.
E. Marks.

PAST PRESIDENTS.

	Elected
EDWIN LANKESTER, M.D., F.R.S. - - -	July, 1865.
ERNEST HART - - - - - - -	„ 1866.
ARTHUR E. DURHAM, F.L.S., &c. - - -	„ 1867.
„ „ - - - -	„ 1868.
PETER LE NEVE FOSTER, M.A. - - - -	„ 1869.

REPORT OF THE COMMITTEE.

In presenting the Fifth Annual Report, the Committee of the Quekett Microscopical Club desire to congratulate the members upon the continued prosperity and success that still attends its progress; a success that may be attributed to the well-sustained determination of the members individually to fulfil the objects for which the Club was founded.

By the kind courtesy of the authorities of University College, the Committee are still enabled to enjoy the highly prized privilege of meeting within its walls; a privilege which confers on the Club many and great advantages, and which it must always warmly appreciate.

The Quekett Microscopical Club now meets without a recess twice in every month throughout the year; thus affording the members those frequent opportunities of inter-communication which are so invaluable in the mutual assistance they render in the comparison of notes and specimens. The meetings are generally well attended on each occasion. The average attendance on the second Friday in the month, when members meet for the exhibition of Microscopic Objects and for mutual gossip on Microscopical subjects, is 45; while at the ordinary meeting, on the fourth Friday,

the average attendance of members amounts to 112. Your Committee desire especially to call the attention of the members to the many pleasant advantages derivable from the meetings on the gossip nights; for on these occasions, difficulties in Microscopical manipulation and the various methods of mounting Microscopic Objects are communicated and discussed, and while an interchange of thoughts and plans is freely given, friendships are formed that are destined to be lifelong. They therefore feel that these advantages only require to be known, to ensure a more thorough appreciation by the general body of the members, and a larger attendance on these pre-eminently social evenings.

A reference to the list of papers read before the Club during the past session, embracing various subjects in relation to Microscopical science, will show that members have not been idle, but have come forward to assist in that mutual edification which is one of the objects for which the Quekett Microscopical Club was founded, and which your Committee hope to see emulated and copied by many others in the Club during the ensuing year.

The Slides in the Cabinet of the Club still continue to increase by the liberal contributions of members and others, and now number 1,430. The following have been presented during the past year, viz.:—

M. Alphonse de Brebisson . .	26
Mr. C. Bennett	2
,, M. C. Cooke	100
,, G. Conder	7
,, Curties	3
,, ,, from Friends . .	12
,, Golding . . .	1

Mr. H. F. Hailes . . .	1
" E. Kiddle	2
" Kitton	1
" R. T. Lewis	7
" Wm. Moginie . . .	3
" G. E. Quicke	12
" Tatem	1
Miss Webb	3
Mr. T. C. White	7
	188
Previous Donations . .	1242
In the Cabinet . .	1430

Your Committee beg to offer the following suggestion to the consideration of the members: they feel certain that, if when members mounted a Slide for themselves they would make a second one for the Cabinet, the Club would soon possess a collection for circulation and reference which no other society could surpass, and which would be of inestimable advantage in the identification and naming of objects.

Several important additions have been made to the Library by the donations of friends and members, as well as by purchase; and your Committee desire from time to time to add still further to the efficiency of this department of the Club.

The fortnightly Excursions during the summer months continue to be well supported, and are amongst the most enjoyable features of the Club; by joining in these, the members gain an insight into the best modes of collecting natural objects of Microscopical interest, which could not be attained so easily in their solitary and unassisted rambles.

The Annual Soirée of the Club was held, by permission, at University College, on March 11th, and was attended by over 1000 members and visitors. Many objects of interest were exhibited, and the Committee desire on this occasion again to thank those gentlemen who so kindly came forward to support them by their interesting contributions towards the evening's entertainment.

To prevent the overcrowding consequent upon the increase in the number of members and the limited space at command, your Committee deemed it advisable to restrict the number of cards of invitation this year, but announced that any member desirous of extra tickets could procure them upon payment of 2s. 6d. each. This plan resulted in greater comfort for those who attended, while the proceeds of the sale were handed over by your Committee, in the name of the Club, to the funds of University College Hospital.

The number of members now in the Club, after making a deduction on account of deaths, removals, and defaulting members, amounts to 509—57 of which have joined since the last annual meeting; and although this number is lower than that presented last year, yet your Committee believe that it represents men whose interest in Microscopical research warrants them in looking forward to the future with a pleasing prospect in more abundant Microscopical work, and an increased warmth in carrying out the objects for which the Club was founded.

Your Committee gladly avail themselves of this opportunity of expressing their thanks to Mr. R. T. Lewis, their Honorary Reporter, to Mr. Edward Jaques, the Honorary Librarian, and to Mr. G. W. Ruffle, the Honorary Curator; also to Messrs. Arnold, Gay, Reeves and Suffolk, the Excursion Committee, and to Messrs. Bockett, Hailes,

Hislop and Marks, the Exchange of Slides Committee, and to acknowledge the very efficient manner in which they have respectively carried out the working of their different departments.

Upon taking a retrospective glance over the career of the Quekett Microscopical Club during the period it has been in existence, one cannot but be struck by the fact of its rapid increase and growth. Five years ago it was represented by eleven individuals, warm, ardent and zealous in the pursuit of Microscopical knowledge; and in the comparatively short space of time that has since elapsed, over 600 members have sought and obtained election in the Club. Most of these gentlemen remain with us to the present time, all imbued with a strong desire to seek out the unfathomable stores of interest revealed by the Microscope, and all influenced by that insatiable thirst for the observation of the minute and the beautiful, that only the Microscope can open up to view. Looking at the Club as constituted of members such as these, your Committee hope that the year to come may be marked by still greater progress in the furtherance of the objects for which the Club was instituted, and that each member may strive in systematic work to emulate him whose name is so closely associated with its title.

July 22nd, 1870.

PAPERS READ DURING THE YEAR.

Mr. James J. Field -	On the Ratio-Micro-Polariscope.
,, G. W. Hart - -	,, Oyster Culture.
,, W. Hislop - - -	,, A New Analysing Selenite Stage.
Dr. Matthews - - -	,, A New and Simple Form of Micrometer.
The late Dr. J. J. Wright	,, The Harvest Bug.
Mr. B. T. Lowne - -	,, The Aid to Animal Classification derivable from the Microscope.
,, H. F. Hailes - -	,, A portion of Human Skin from a door in Westminster Abbey.
,, W. Hislop - - -	,, A New and Simple Form of Rotating Selenite Stage.
,, M. C. Cooke - -	read a Translation of Count Castracane's Paper on Micrometric Measurement.
,, B. T. Lowne - -	A Resumé of some of his work on the Anatomy of the Blow Fly done during the year.
,, T. C. White - -	,, The Crystallization of Hippuric Acid
Dr. Robert Braithwaite,	On the Geographical distribution of Mosses.
Mons. Alphonse de Brebisson,	On Critical Notes on British and Foreign Diatoms.
Mr. B. T. Lowne - -	On the Microscopical Structure of the Cornea of the African Carpenter Bee.
,, M. C. Cooke - -	,, Microscopic Moulds.
,, N. E. Green - -	,, Ciliary Action in the Flosculariaus.
,, J. G. Waller - -	,, The Conjugation of Actinophrys Sol.
Dr. Matthews - - -	,, A New and Improved Form of Turntable.
,, ,, - - -	,, A Method of Sub-stage Illumination.
Mr. Kitton - - - -	,, The Diatoms of the Morz Deposit of Jutland.

TREASURER'S REPORT.

JUNE 30TH, 1870.

RECEIPTS.

	£	s.	d.	£	s.	d.
Balance in hand last Audit				22	19	3
To Cash received, viz.:—						
Composition Fee	10	0	0			
Annual Subscriptions	222	10	0			
Sale of Soirée Tickets	5	7	6			
,, Journal	4	0	0			
				241	17	6
				£264	16	9

PAYMENTS.

	£	s.	d.
Printing and Stationery	28	9	8
Postages	10	11	8
Advertisements	1	19	0
Attendants	11	0	0
Property Purchased	16	14	3
Deposit Note at City Bank	10	0	0
Petty Expenses	5	10	3
Presentation of Amount realised by Sale of Soirée Tickets to University College Hospital	5	7	6
Expenses of Journal	91	15	2
Expenses of Soirée	57	0	3
Balance at Banker's	26	9	0
	£264	16	9

ROBERT HARDWICKE, *Treasurer.*

We, the undersigned, having examined the above statement of Income and Expenditure, and the Vouchers referring thereto, hereby certify that the said Account is correct.

W. T. SUFFOLK,
FRED. OXLEY, } *Auditors.*

HONORARY FOREIGN MEMBERS.

Date of Election.	
Oct. 25, 1867	Guiseppe de Notaris, *Professor of Botany, &c., &c.,* Genoa.
Jan. 24, 1868	Arthur Meade Edwards, M.D., 314 West Thirty-fourth-street, New York.
Mar. 19, 1869	Rev. E. C. Bolles (*Ex-President of the Portland Society of Natural History*), Brooklyn, New York.
Mar. 19, 1869	Alphonse de Brebisson (*Author of numerous contributions on the Desmidiaceæ and Diatomaceæ*), Falaise, Normandy, France.

LIST OF MEMBERS.

Date of Election.	
Sept. 24, 1869	Ackland, William, 122 Newgate-street, E.C.
April 22, 1870	Adams, William, F.R.C.S., 37 Harrington-square, N.W.
Nov. 27, 1868	Adkins, William, 270 Oxford-street, W.
Oct. 27, 1865	Aldous, W. Lens, 47 Liverpool-street, W.C.
Mar. 23, 1866	Allbon, W., F.R.M.S., 525 New Oxford-street, W.C.
Jan. 22, 1869	Allder, J. R., 5 Suffolk-street, Rotherfield-street, Islington, N.
Sept. 27, 1867	Allen, John T., 57 Cross-street, Islington, N.
July 23, 1869	Allen, W. H., C.E., 2 Abingdon-villas, Kensington, W.
Dec. 17, 1869	Ames, George Acland, Union Club, Trafalgar-square, S.W.
Sept. 25, 1868	Andrew, Arthur R., 3, Neville-terrace, Fulham-road, S.W.
Dec. 22, 1865	Andrew, F. W., 3 Neville-terrace, Fulham-road, S.W.
Sept. 22, 1865	Annett, James, Hampton, S.W.
July 7, 1856	Archer, J. A., 172 Strand, W.C.
Oct. 27, 1865	Arnold, W. J. de L., 6 Stamford-villas, Fulham, S.W.
Dec. 18, 1868	Ashby, John, Staines.
Jan. 28, 1870	Atkinson, William, 38 Medina-road, Holloway, N.
Dec. 22, 1865	Atkinson, John, 54 Brook-street, W.
Feb. 26, 1869	Atkinson, William, F.L.S., 47 Gordon-square, W.C.
Mar. 27, 1868	Aubert, Alfred, Lloyds, E.C.

Date of Election.	
May 22, 1868	Bailey, Capt. L. C., R.N., F.R.G.S., R.A.S., Topographical Dept., New-st., Spring-gardens, S.W.
July 26, 1867	Bailey, George H., M.R.C.S., 25 Charles-street, Middlesex Hospital, W.
Dec. 27, 1867	Bailey, John W., 162 Fenchurch-street, E.C.
April 24, 1868	Baker, Charles, F.R.M.S., 244 High Holborn, W.C.
Aug. 23, 1867	Bannister, Richard, F.R.M.S., The Laboratory, Somerset-house, W.C.
Jan. 26, 1866	Barber, John, F.R.M.S., 29 Brunswick-gardens.
April 22, 1870	Barnes, Charles Barritt, 66, Old Broad-street, E.C.
Oct. 27, 1865	Barratt, T. J., 91 Great Russell-street, W.C.
June 24, 1870	BEALE, LIONEL S., M.B., F.R.S. (*President*), 61 Grosvenor-street, W.
June 25, 1869	Beale, Charles J., 118 Englefield-road, Islington, N.
Dec. 27, 1867	Bealey, Adam, M.D., Oak Lea, Harrogate.
May 28, 1869	Bean, Charles E., Brooklyn House, Goldhawk-road, Shepherd's Bush, W.
Aug. 23, 1867	Beazeley, Joseph, 17 Little Tower-street, E.C.
Oct. 26, 1866	Beck, Joseph, F.R.M.S., 31 Cornhill, E.C.
Aug. 23, 1867	Bell, James, F.R.M.S., The Laboratory, Somerset-house, W.C.
Mar. 19, 1869	Bennett, L., 30 Gloucester-street, Pimlico, S.W.
Dec. 27, 1867	Bentley, C. S., Hazellville Villa, Sunnyside-road, Hornsey-rise, N.
May 22, 1868	Berney, John, F.R.M.S., 61 North-end, Croydon.
Oct. 23, 1868	Bevington, W. A., 113 Grange-road, S.E.
Mar. 27, 1868	Bidlake, J. P., B.A., F.C.P., F.C.S., F.R.M.S., 318 Essex-road, N.
June 24, 1870	Birch, A. E., 47 Halliford-street, Islington, N.
Jan. 25, 1867	Bird, Peter Hinckes, M.D., 1 Norfolk-square, Hyde-park, W.
April 22, 1870	Black, William, Abchurch House, Sherborne-lane, E.C.
Nov. 22, 1867	Blake, F. W., 5 Serle-street, Lincoln's-inn, W.C.
Feb. 23, 1866	Blake, T., 6 Charlotte-terrace, Brook-green, Hammersmith, W.
Mar. 19, 1869	Blankley, Frederick, F.R.M.S., 23 Belitha-villas, Barnsbury, N.

Date of Election.	
Mar. 19, 1869	Blight, Rev. R., The Vicarage, Bredwardine, Hereford.
July 7, 1865	Bockett, John. F.R.M.S., 10 Willingham-terrace, Leighton-road, Kentish-town, N.W.
April 24, 1868	Bodkin, W. P., Merton-lane, Highgate-rise, N.
June 25, 1869	Bond, George, 11 St. Thomas'-place, Hackney, N.E.
April 22, 1870	Bossy, Alfred Horsley, Prospect Cottages, Stoke Newington, N.
Nov. 27, 1868	Boustead, James, Stourfield Lodge, Effra-road, Brixton, S.E.
Mar. 27, 1868	Bowing, John, 6 Bowater-crescent, Woolwich, S.E.
July 23, 1869	Boyer, Richard, 20 Park-terrace, Highbury, N.
Oct. 23, 1868	Brabham, T., 61 Castle-st., Leicester-square, W.C.
Dec. 22, 1865	Brain, T., Buckingham-house, Buckingham-road, De Beauvoir-town, N.
Oct. 27, 1865	Braithwaite, R., M.D., M.R.C.S.E., F.L.S., F.R.M.S. (*Vice-President*), The Ferns, Clapham-rise, S.W.
Nov. 24, 1865	Breese, C. J., F.R.M.S., The Ferns, Lyonsdown-road, New Barnet.
Dec. 17, 1869	Brewin, Arthur, F.R.A.S., F.R.M.S., 2 Copthall-chambers, Throgmorton-street, E.C.
June 26, 1868	Briggs, H. B., 36½ Upper Thames-street, E.C.
May 27, 1870	Brigham, H. G., St. George's Hospital, S.W.
Mar. 22, 1867	Brightween, G., 8 Finch-lane, E.C.
Jan. 22, 1869	Brookes, William, 380 Camden-road, Holloway, N.
May 27, 1870	Brown, George Dransfield, M.R.C.S., Uxbridge-road, Ealing, W.
Dec. 28, 1866	Brown, W., 203 Great Portland-street, W.
May 22, 1868	Brown, W. J., 37 Penshurst-road, South Hackney, E.
May 24, 1867	Browne, H., 40 Camden-square, N.W.
May 25, 1866	Buchanan, A., 382 Camden-road, N.
Jan. 28, 1870	Bull, William J., M.A., Harrow.
Mar. 25, 1870	Burckhardt, Edmund, 105 Gaisford-street, Kentish-town, N.W.
Sept. 28, 1866	Burgess, J. W., 329 Hackney-road, N.E.
Feb. 23, 1866	Burgess, N., 329 Hackney-road, N.E.
June 25, 1869	Burgess, W. F., Guy's Hospital, S.E.

Date of Election.	
Aug. 26, 1870	Burgess, Martin, 3 Mount Pleasant-place, New Cross, S.E.
April 24, 1868	Burr, T. W., F.R.A.S., F.C.S., F.R.M.S., 15 Tiberton-square, N.
Oct. 23, 1868	Burrows, C. R. N., Wanstead, Essex, N.E.
April 24, 1868	Burrows, John, Wanstead, N.E.
Mar. 27, 1868	Burrows, J. Nelson, The Grove, Wanstead, N.E.
June 14, 1865	Bywater, Witham M., F.R.M.S., 5 Hanover-square, W.
July 27, 1866	Bywater, W. M., jun., 5 Hanover-square, W.
May 24, 1867	Callaghan, James, 12 Coal-yard, W.C.
Aug. 23, 1867	Cameron. J., The Laboratory, Somerset-house, W.C.
Sept. 25, 1868	Capel, Charles C., Little Blake Hall, Wanstead, Essex.
Dec. 27, 1867	Chapman, W. C., 39 Granville-square, W.C.
Nov. 26, 1869	Chater, E. M., Watford, Herts.
Oct. 25, 1867	Clabon, J. M., F.G.S., 4 St. George's-terrace, Regent's-park, N.W.
Aug. 26, 1870	Carpenter, John, 38 Cornwall-street, Fulham, S.W.
Aug. 26, 1870	Clarkson, Frank, F.G.S., 2 Squire's Mount Cottages, Hampstead.
Mar. 22, 1867	Clover, Jos., T., 3 Cavendish place, Cavendish-square, W.
May 22, 1868	Cocks, W. G., 18 Kent-villas, Grange-road-east, Dalston, N.E.
Dec. 10, 1868	Coe, W. E., 31 Gaisford-st. Kentish-town-road, N.W.
May 28, 1869	Cole, Walter B., 17 Mary-street, Weymouth.
Jan. 25, 1867	Coles, Ferdinand, A.P.S., 248 King's-road, Chelsea, S.W.
April 23, 1869	Collings, Thomas P., 38 Surrey-street, Strand, W.C.
July 7, 1865	Collins, C., F.R.M.S., 77 Great Titchfield-street, W.
May 22, 1868	Collins, Jas., 11 Arthur-street, Deptford, S.E.
Mar. 19, 1869	Conder, Geo., Plough-court, Lombard-street, E.C.
Mar. 19, 1869	Cooke, Geo. E., 1 Loddiges-terrace, Hackney, N.E.
June 14, 1865	Cooke, M. C. (*Sect. for Foreign Correspondence*), 2 Junction-villas, Upper Holloway, N.

Date of Election.	
Feb. 22, 1867	Cooper, Frank W., L.R.C.S. Edin., Leytonstone, N.E.
Mar. 23, 1869	Coppock, C., F.M.S., F.M.R.S., 31 Cornhill, E.C.
Dec. 17, 1869	Coppock, Jones Henry, Bridport, Dorset.
May 28, 1869	Cottam, Arthur, F.R.A.S., Office of Woods, Whitehall, S.W.
Aug. 28, 1868	Cousens, John, Grove-road, Wanstead, N.E.
July 23, 1869	Creer, Edwin A. O., 2 Albany-place, Commercial-road East, E.
Aug. 4, 1865	Cresy, E., Metropolitan Board of Works, Spring-gardens, S.W.
Aug. 28, 1868	Crisp, Frank, 134 Adelaide-road, N.W.
Feb. 27, 1868	Crook, Thomas, F.R.M.S., Grosvenor-villa, Cleveland-road, Surbiton, S.W.
Oct. 26, 1866	Crookes, Wm., F.R.S., 20 Mornington-road, N.W.
July 7, 1865	Crosbie, J. J., 11 Grange-road, Canonbury, N.
July 26, 1867	Cross, R., M.D., 21 New-street, Spring-gardens, S.W.
Sept. 28, 1866	Crouch, Henry, F.R.M.S., 54 London-wall, E.C.
Mar. 27, 1868	Cubitt, Charles, F.R.M.S., 3 Great George-street, Westminster, S.W.
May 25, 1866	Curties, T., F.R.M.S., 244 High Holborn, W.C.
June 25, 1868	Darnley, D. Rowland, 12 John-street, Bedford-row, W.C.
April 27, 1866	Davis, S., 11 Priory-road, South Lambeth, S.W.
Oct. 22, 1869	Davis, Henry, 19 Warwick-street, Leamington.
May 25, 1866	Dawson, J. E., F.R.M.S., Oak Lodge, Park-road, Watford.
May 22, 1868	Dean, G. A. H., Elmwood, Catford-bridge, Kent, S.E.
Jan. 22, 1869	Deed, Alfred, 4 Eton-villas, Haverstock-hill, N.W.
Nov. 27, 1868	Delferier, Wm., F.R.M.S., 40 Sloane-square, S.W.
April 23, 1869	Delferier, Arthur, 40 Sloane-square, S.W.
Feb. 27, 1868	Dempsey, Joseph M., M.D., F.R.M.S., 27 Charterhouse-square, E.C.
July 23, 1869	Devenish, Samuel, 2 Champion-grove, Denmark-hill, S.E.
June 26, 1868	Dickens, Charles, Stanstead-park, Forest-hill, S.E.

Date of Election.	
Feb. 25, 1870	Diss, William Jas., 17 Spurstowe-road, Amherst-road, Hackney, N.E.
Dec. 22, 1865	Dix, James, 26 Pentonville-road, N.
Nov. 24, 1865	Dobson, H. H., F.R.M.S., Pelham Lodge, Alexandra-road, St. John's-wood, N.W.
Jan. 25, 1867	Dodd, Josiah E., 11 Margaret-street, Cavendish-square, W.
Aug. 28, 1868	Donaldson, Alexander L., 14 Wigmore-street, W.
Nov. 27, 1868	Douglas, Rev. R. C., Manaton Rectory, Moreton-hampstead, Exeter.
Jan. 28, 1870	Dowson, Edward, M.D., F.R.M.S., 117 Park-street, Grosvenor-square, W.
Dec. 27, 1867	Draper, E. T., F.R.M.S., Harringay-park, Hornsey, N.
May 22, 1868	Dresser, W. G., 68 Westbourne-road-north, Barnsbury, N.
Sept. 22, 1865	DURHAM, ARTHUR E., F.L.S., F.R.M.S. *(Vice-President)*, 82 Brook-street, Grosvenor-square, W.
Nov. 23, 1866	Durham, F., 14 St. Thomas-street, Borough, S.E.
Aug. 26, 1868	Duer, Y., Cleygate, near Esher, Surrey.
Sept. 25, 1868	Eddy, James Ray, F.R.M.S., F.G.S., Carleton-grange, Skipton, Yorkshire.
Jan. 28, 1870	Edmonds, F. L., 2 York-street, St. James's, S.W.
June 28, 1867	Edmonds, R., 176 Burrage Road, Plumstead, S.E.
July 26, 1867	Eldridge, John R., 19 Downshire-hill, Hampstead, N.W.
July 27, 1865	Emery, J. J., 99 St. George's-road, Southwark, S.E.
Sept. 24, 1869	Epps, Richard, M.R.C.S., 89 Great Russell-street, Bloomsbury.
May 28, 1869	Evans, Edward, 12 Surrey-villas, Norwood, S.E.
Feb. 26, 1869	Evans, Fredk., 51 Malpas-road, New-cross, S.E.
Dec. 18, 1868	Eyre, Samuel, 10 Upper Lansdowne-road-north, South Lambeth, S.E.

Date of Election.	
May 28, 1869	Farmer, Richard, F.R.M.S., F.G.S., Hornsey, N.
Dec. 18, 1868	Farmer, Robert J., 5 Great Turnstile, Holborn, W.C.
Nov. 23, 1866	Fawn, George, 19 Alexandra-road, St. John's-wood, N.W.
Mar. 27, 1868	Field, James, High-street, Highgate, N.
July 26, 1867	Fitch, Frederick, F.R.G.S., F.R.M.S., Hadleigh-house, Highbury New-park, N.
May 22, 1868	Ford, W. B., Claremont-cottage, Colney-hatch-road, Wood-green.
Aug. 4, 1865	FOSTER, P. LE NEVE, M.A. (*Vice-President*), Society of Arts, Adelphi, W.C.
Aug. 24, 1866	Foster, P., F.L.S., Belsize-lane, Hampstead, N.W.
April 22, 1870	Foster, John, 213 Regent-street, W.
Oct. 22, 1869	Fox, Charles James, M.R.C.S., 27 Mortimer-street, W.
Dec. 28, 1866	Fox, C. J., F.R.M.S., 16 Cork-street, Bond-street, W.
Mar. 27, 1868	Fox, John James, Devizes.
Feb. 26, 1869	Fricker, C. J., 4 Weston-hill-terrace, Upper Norwood, S.E.
June 26, 1868	Fry, Rev. James, M.A., F.R.M.S., South-grove-house, Tonbridge-wells.
May 22, 1868	Fryer, G. Henry, F.R.M.S., 13 West Abbey-road, St. John's-wood, N.W.
May 28, 1869	Fryer, G. H., 22 North-road, Clapham-park, S.W.
Oct. 26, 1868	Furlonge, W. H., 4 Oxford-road, Hammersmith, W.
Mar. 19, 1869	Gann, James W., 171 Fenchurch-street, E.C.
Mar. 25, 1870	Garden, Robert Spring, 42 Carlton-hill, St. John's-wood, N.W.
May 25, 1866	Gardiner, G., 244 High Holborn, W.C.
April 24, 1868	Garnham, John, F.R.M.S., 123 Bunhill-row, E.C.
July 7, 1865	Gay, F. W., F.R.M.S., 113 High Holborn, W.C.
Sept. 22, 1865	Geddes, P., Millbank, Westminster, S.W.
Jan. 28, 1870	Gellatly, Peter, Loughton, Essex.
July 26, 1867	George, Edward, F.R.M.S., 12 Derby-villas, Forest-hill, S.E.

Date of Election.	
Mar. 22, 1867	George, Henry, 65 Castle-street, Oxford-market, W.
July 22, 1870	Gibson, Joseph F., 3 Furnival's-inn, E.C.
June 14, 1865	Gibson, W., 9 Lupus-street, Pimlico, S.W.
Aug. 23, 1867	Gilbert, C. H. D., 65 Ludgate-hill, E.C.
Nov. 23, 1866	Gill, F. W., Bedford-villas, Croydon.
June 14, 1865	Godley, E. R., 7 Catherine-terrace, Lansdowne-road, Stockwell, S.W.
Nov. 22, 1867	Golding, W. H., 73 Mark-lane, E.C.
Oct. 26, 1866	Gooch, James W., 23 High-street, Eton.
Dec. 22, 1865	Goode, W., 8 Bath-terrace, Lavender-hill, Wandsworth-road.
Feb. 22, 1867	Gostling, W., Edgecumbe-villa, Upper Tooting, S.W.
Aug. 27, 1869	Gowan, G. O., 20 Beauchamp-square, Leamington.
Mar. 27, 1868	Gray, S. Octavus, 44 Doughty-street, W.C.
Dec. 22, 1865	Gray, W. J., M.D., F.R.M.S., 41 Queen Anne-street, Cavendish-square, W.
Feb. 25, 1870	Gray, Peter, 52 Packington-street, N.
Feb. 25, 1870	Gray, Henry J., 5 Lower Craven-place, Highgate-road, N.W.
Jan. 28, 1870	Green, Nathaniel E., 3 Circus-road, St. John's-wood, N.W.
Jan. 22, 1869	Greenfield, Basil E., 6 Gordon-square, W.C.
Oct. 23, 1868	Greenish, T., 20 New-street, Dorset-square, N.W.
Oct. 23, 1868	Gregory, Henry R., 10 Edith-grove, Fulham-road, S.W.
May 25, 1866	Griffiths, A. W., 41 Clerkenwell-green, E.C.
July 24, 1868	Groves, J. W., 25 Charlotte-st., Bedford-sq., W.C.
July 24, 1868	Grubbe, E. W., C.E., 49 Queen's-gardens, Hyde-park, W.

June 14, 1865	Hailes, Henry F., 7 Harringay-road, Hornsey, N.
Aug. 26, 1870	Hailstone, Robert H., 35, Walworth-road, S.E.
Aug. 23, 1867	Hainworth, John, 138 Camden-road, N.W.
Feb. 23, 1866	Hainworth, W., Jun., Clare-villa, Critcketfield-road, Lower Clapton.
Mar. 19, 1869	Hall, Marshall, F.G.S., F.C.S., 3 Cleveland-terrace, Hyde-park, W.

Date of Election.	
Dec. 28, 1866	Hallett, R. J., Hawthorn-cottage, Kilburn, N.W.
Oct. 26, 1866	Halley, Alexander, M.D., 7 Harley-street, W.
Feb. 22, 1869	Hammond, A., 3 Alexander-road, Marine-town, Sheerness.
Oct. 22, 1869	Harcourt, Cyril B., 35 St. George's-square, S.W.
June 14, 1865	Hardwicke, Robert, F.L.S. (*Treasurer*), 192 Piccadilly, W.
Feb. 22, 1869	Harker, John W., F.R.M.S., 24 Upper Barnsbury-street, N.
Sept. 28, 1866	Harkness, W., F.R.M.S., Laboratory, Somerset-house, W.C.
Jan. 22, 1869	Harper, J., Claremont-house, Chaucer-road, Brixton, S.E.
May 22, 1868	Harris, W. H., F.C.S., Buckby Wharf, Northamptonshire,
Aug. 24, 1866	HART, ERNEST, 42 Harley-street, W.
Oct. 26, 1866	Hart, G. W., Mengeham-house, Hayling, Havant.
Nov. 26, 1869	Hart, Edward, Highbury New-park.
Aug. 23, 1867	Harvey, Wm., 38 Dale-road, Haverstock-hill, N.W.
June 28, 1867	Hawksley, Thos. P., 4 Blenheim-street, Oxford-street, W.
June 24, 1870	Hawkins, Samuel J., 2 Upper Park-road, Colney-hatch, N.
May 27, 1870	Hayward, Henry, Dartmouth-terrace, Rotherhithe, S.E.
Aug. 28, 1868	Heawood, Francis R. H., 80 Mark-lane, E.C.
Jan. 25, 1867	Heisch, Charles, F.R.M.S., 69, Jermyn-street, St. James's, S.W.
Aug. 23, 1867	Helm, Henry J., F.R.M.S., The Laboratory, Somerset-house, W.C.
Aug. 26, 1870	Hennell, Col. S., F.R.M.S., Ventnor-villa, Ventnor, Isle of Wight.
June 26, 1868	Henry, A. H., 49 Queen's-gardens, Hyde-park, W.
May 22, 1868	Hewitt, B. A., 9 Percy-villas, Upper Norwood, S.E.
May 22, 1868	Hicks, J. J., 8 Hatton-garden, E.C.
Nov. 24, 1868	Hide, T. C., 46 Fenchurch-street, E.C.
June 14, 1865	Highley, S., F.G.S., 10A Great Portland-street, W.
Sept. 24, 1869	Hilton, J. D., M.D., Upper Deal, Deal, Kent.
Dec. 17, 1869	Hill, D. W., 378 Camden-road, N.

Date of Election.	
May 22, 1868	Hill, W. T., 4 Trinidad-place, Liverpool-road, N.
Sept. 28, 1866	Hind, F. H. P., 4 Pall-mall-east, S.W.
Nov. 23, 1866	Hinton, James, 18 Savile-row, W.
Aug. 26, 1870	Hirst, John, Jun., F.R.M.S., Dobcross, near Manchester.
Aug. 4, 1865	Hislop, W., F.R.A.S., 177 St. John-street-road, Clerkenwell, E.C.
Oct. 26, 1866	Holdernesse, W. B., 12 Park-street, Windsor.
May 22, 1868	Holdsworth, Joseph, 54 Lombard-street, E.C.
Mar. 22, 1867	Holmes, Samuel, 12 Brunswick-terrace, Lower-road, Rotherhithe, S.E.
July 24, 1868	Holmes, W., M.R.C.S., 1 Brighton-villas, Lower Norwood, S.E.
April 27, 1866	Holtzapffel, J., A.I.C.E., 5 Great Coram-st., W.C.
April 26, 1867	Hooton, C., 3 Horningston-villas, Junction-rd., N.
May 22, 1868	Hopkinson, J., F.R.M.S., 8 Lawn-road, Haverstock-hill, N.W.
July 23, 1869	Horn, William E., 50 Bessborough-street, S.W.
May 27, 1870	Horn, T. W., 6 Clarence-road, Finsbury-park, N.
Oct. 26, 1866	Horncastle, H., Edwinstowe, near Ollerton, Notts.
June 25, 1869	Houghton, W., Walthamstow, Essex.
April 26, 1867	Hovenden, F., 93 City-road, E.C.
Mar. 27, 1868	How, James, F.R.M.S., 2 Foster-lane, E.C.
Feb. 25, 1870	Hudleston, W. H., F.G.S., J.P., 23 Cheyne-walk, S.W.
Oct. 23, 1868	Hughes, R. H., B.A. Jesus Coll., Camb., 6 The Terrace, Putney, S.W.
June 25, 1869	Humphreys, Hy., B.A., 9 Amhurst-road-west, N.E.
Dec. 28, 1866	Hunt, W. H. B., F.R.M.S., 23 Eversholt-street, Oakley-square, N.W.
May 24, 1867	Hutchinson, F., M.D., 29 Woburn-place, Russell-square, W.C.
May 28, 1869	Ibbetson, D., 68 Amberley-road, Harrow-road, Bayswater, W.
May 24, 1867	Ingpen, John E., F.R.M.S., 7 Putney-hill, S.W.
Dec. 17, 1869	Jackson, B. D., 2 Morland-villas, Gresham-road, Brixton, S.W.

Date of Election.	
July 24, 1868	Jackson, F. R., Maple-villa, West Dulwich, S.E.
June 14, 1865	Jaques, Edward, F.R.M.S. (*Librarian*), Woods and Forests Office, Whitehall, S.W.
June 26, 1868	Jeakes, Lt.-Colonel, Winchester Hall, Highgate, N.
April 23, 1869	Jefferson, Thomas, 17 The Pavement, Clapham Common, S.W.
July 24, 1868	Jennings, Rev. Nathaniel, M.A., F.R.A.S., 66 Avenue-road, Regent's-park, N.W.
Jan. 24, 1868	Jewell, C. C., 2 Great Queen-street, W.C.
July 22, 1870	Johnson, F., Barnsbury House School, Islington, N.
Jan. 25, 1867	Johnson, John A., 15 Wellington-road, Stoke Newington, N.
Jan. 26, 1866	Johnson, R. G., Horbury-villa, Ladbroke-square, Notting-hill, W.
Mar. 19, 1869	Jonas, L. E., 13 Canterbury-villas, Maida-vale, N.W.
Dec. 18, 1868	Jordan, James B., 11 Grafton-square, Clapham, S.W.
Oct. 26, 1866	Kemp, Robert, 25 Junction-rd., Upper Holloway, N.
Oct. 26, 1866	Kent, W. S., F.R.M.S., F.Z.S., The Geological Department, British Museum, and 16 Tavistock-street, Bedford-square, W.C.
June 14, 1865	Ketteringham, T., 51 Coleshill-street, Eaton-sq., S.W.
Aug. 23, 1867	Kiddle, Edward, The War Office, Pall-mall, S.W.
Mar. 19, 1869	Kilsby, Thomas W., Upper Fore-street, Edmonton, N.
July 7, 1865	King, G. H., 190 Great Portland-street, W.
July 22, 1870	King, Henry, 65 Myddelton-square, E.C.
April 26, 1867	Kirk, Joseph, 11 Blossom-st., Norton Folgate, N.E.
June 24, 1870	Knaggs, Henry G., M.D., 49 Kentish-town-road, N.W.
Oct. 23, 1868	Knevett, S., 18 Montague-street, Russell-sq., W.C.
July 27, 1866	Lambert, T. J., 151 Highbury New-park, N.
Nov. 23, 1866	Lambert, W., 4 New Basinghall-street, E.C.

Date of Election.	
Aug. 24, 1866	Lampray, John, F.R.G.S., F.A.S.L., F.R.M.S., 16 Camden-square, N.W.
Mar. 22, 1867	Lancaster, Thos., Brownham-house, Stroud, Gloucestershire.
July 22, 1870	Lang, Alfred Graham, Guy's Hospital, S.E.
Dec. 28, 1866	Langrish, H., 250 Pentonville-road. N.
Aug. 4, 1865	LANKESTER, EDWIN, M.D., F.R.S., F.L.S., F.R.M.S., Melton House, Child's-hill, Hampstead, N.W.
Feb. 26, 1869	Lavey, Charles, 341 City-road, E.C.
April 23, 1869	Lawson, Henry, M.D., 8 Nottingham-place, W.
June 25, 1869	Layton, Charles E., 8 Upper Hornsey-rise, N.
Aug. 28, 1868	Leaf, C. J., F.L.S., F.R.M.S., &c. (*President of the Old Change Microscopical Society*), Old Change, E.C.
Mar. 19, 1869	Lee, Henry, F.L.S., F.R.M.S., &c. (*Vice-President*), The Waldrons, Croydon.
Oct. 25, 1867	Leifchild, J. R., 42 Fitzroy-street, Fitzroy-square, W.
Sept. 22, 1865	Leighton, W. H., 2 Merton-place, Chiswick, W.
June 25, 1869	Lemmon, Benj., 61 Hungerford-road, Islington, N.
May 28, 1869	Letts, Edmund A., Clare-lodge, Perry-hill, Sydenham, S.E.
Mar. 22, 1867	Lewinsky, John, 13 Frith-street, Soho, W.
Jan. 22, 1869	Lewis, Louis, M.R.C.S. 1 Rutland-street, Regent's-park, N.W.
April 27, 1866	Lewis, R. T., F.R.M.S., 1 Lowndes-terrace, Knightsbridge, S.W.
June 26, 1868	Lindley, W., Jun., Kidbrook-terrace, Blackheath, S.E.
June 25, 1869	Linford, John S., 146 Holborn-bars, W.C.
Dec. 17, 1869	Lloyd, Thos., 17 Holles-street, Cavendish-sq., W.
June 24, 1870	Lockington, Wm. Neale, 34 Coleman-street, City, E.C.
Nov. 24, 1865	Loam, Michael, Hampton, Middlesex, S.W.
April 23, 1869	Long, Henry, 90 High-street, Croydon.
Jan. 26, 1866	Lord, J. K., F.Z.S., Elm-house, Denmark-hill, S.E.
Nov. 24, 1865	Lovibond, J. W., F.R.M.S., 4 Blue-stile, Greenwich-road, S.E.

Date of Election.	
Sept. 22, 1865	Lovick, T., Board of Works, Spring-gardens, S.W.
May 28, 1869	Lowe, Henry W., Clifton-villas, Albert-road, South Norwood, S.E.
Dec. 18, 1868	Lowne, Benjamin Thompson, M.R.C.S., 2 Guildford-street, Russell-square, W.C.
April 27, 1866	Loy, W. T., F.R.M.S., 9 Garrick-chambers, Garrick-street, W.C.
Jan. 24, 1868	Macdonald, J., M.D., 68 Upper Kennington-lane, S.E.
Nov. 23, 1866	McIntire, S. J., F.R.M.S., 22 Bessborough-gardens, S.W.
Oct. 25, 1867	McLeod, R. G., 38 Little Queen-street, W.C.
May 22, 1868	McVean, W., 18 Wood-street, E.C.
June 14, 1865	Marks, E., 25 Gloucester-road, Seven Sisters-road, N.
Dec. 28, 1866	Marsh, W. A., 325 Hackney-road, N.E.
June 26, 1868	Martin, James, 110 Regent-street, W.
Dec. 27, 1867	Martinelli, A., 106 Albany-street, N.W.
Oct. 25, 1867	Marwood, W. G. H., 68 Downham-road, Kingsland, N.
Dec. 22, 1865	Mason, J., Hampton, Middlesex, S.W.
April 26, 1867	Matthews, G. K., St. John's-lodge, Beckenham, Kent, S.E.
May 28, 1869	Matthews, Henry, 60 Gower-street, W.C.
Oct. 26, 1866	Matthews, John, M.D., 4 Mylne-street, Myddelton-square, E.C,
June 28, 1867	Matthews, Peter, L.D.S., F.Z.S., F.R.M.S., 17 Lower Berkeley-street, W.
Sept. 24, 1869	Matthews, William, 374 Camden-road, N.
Aug. 27, 1869	Mavor, William Samuel, 91 Park-street, Grosvenor-square, W.
July 7, 1865	May, W. R., 20 Trinidad-place, Islington, N.
Mar. 22, 1867	Meacher, John W., 10 Hillmarten-road, Camden-road, N.
May 27, 1870	Medlock, Henry, M.D., 22 Tavistock-square, W.C.
Dec. 18, 1868	Mestayer, Richard, F.L.S., F.R.M.S., 7 Buckland-crescent, Belsize-park, N.W.

Date of Election.	
April 22, 1870	Michels, John, Castelnau-villas, Barnes, Surrey.
Mar. 19, 1869	Midwinter, Edward, 1 Paul-street, Finsbury, E.C.
May 28, 1869	Millar, John, M.D., F.L.S., G.S., R.M.S., &c., Bethnal-house, Cambridge-road, N.E.
June 26, 1868	Milledge, Alfred, 4 Upper Winchester-road, Stanstead-road, Forest-hill, S.E.
Sept. 28, 1866	Miller, Benj., F.R.M.S., 17 St. James's-place, S.W.
July 7, 1865	Millett, F. W., 15 Alfred-street, River-terrace, N.
June 25, 1869	Moggridge, Matthew, F.G.S., 2 Montague-villas, Richmond, Surrey.
May 25, 1866	Moginie, W., F.R.M.S., 35 Queen-square, W.C.
Mar. 27, 1868	Moore, Daniel, M.D., High-street, Hastings.
Oct. 27, 1865	Morrieson, Colonel R., F.R.M.S., Oriental Club, Hanover-square, W.
July 26, 1867	Mott, H. H., 47 Union-grove, Clapham, S.W.
April 24, 1868	Mummery, J. Rigden, F.L.S., F.R.M.S., 10 Cavendish-place, W.
April 24, 1868	Mummery, J. Howard, 10 Cavendish-place, W.
Dec. 18, 1868	Mundie, George, M.R.C.S., 93 Richmond-road, Dalston, N.E.
Jan. 25, 1867	Murray, R. C., 69 Jermyn-street, St. James's, S.W.
Sept. 27, 1867	Nash, Thompson, 101 Mortimer-road, De Beauvoir-square, N.
Mar. 23, 1866	Nation, W. J., 30 King-square, Goswell-road, E.C.
Jan. 26, 1866	Newman, W., 5 Oval-road, Kennington, S.E.
Dec. 18, 1868	Nicholas, T., Ph.D., F.G.S., 3 Craven-street, W.C.
July 7, 1865	Nicholson, D., 51 St. Paul's-churchyard, E.C.
Dec. 22, 1865	Nunn, C. G., Hampton, Middlesex, S.W.
April 26, 1867	Oakley, J. J., F.R.M.S., 183 Piccadilly, W.
Mar. 27, 1868	Oakeshott, John, High-street, Highgate, N.
Dec. 27, 1867	Osborn, C. E., 28 Albert-road, St. John's-ville, Highgate, N.
Dec. 27, 1867	Oxley, F., 3 Crosby-square, Bishopsgate, E.C.
Nov. 27, 1868	Parker, T., 10 Brunswick-square, Camberwell, S.E.

Date of Election.	
April 22, 1870	Parker, Thos. J., 36 Claverton-street, S.W.
Dec. 17, 1869	Parker, William, M.D., 133 Grange-road, Bermondsey, S.E.
June 25, 1869	Pass, H., 11 Spring-terrace, Wandsworth-road, S.W.
May 24, 1867	Pearce, G. T., 39 Clapham-road, S.W.
May 22, 1868	Pearsall, J. S., 38 Denbigh-street, Pimlico, S.W.
May 24, 1867	Pearson, John, 212 Edgware-road, W.
May 28, 1869	Pepler, W. B., Market Lavington, Wilts.
Oct. 25, 1867	Peppin, S. H., 25 Princes-st., Leicester-square, W.
Nov. 26, 1869	Perken, Edmund, 24 Hatton-garden, E.C.
July 23, 1869	Perry, F. J., 46 Bookham-street, Hoxton, N.
Oct. 27, 1865	Pickard, J. F., 1 Bloomsbury-street, W.C.
Jan. 22, 1869	Pillischer, M., F.R.M.S., 88 New Bond-street, W.
June 25, 1869	Pocock, Lewis, jun., 70 Gower-street, W.C.
July 23, 1869	Pocock, Thos. Willmer, 10 Ampthill-square, N.W.
Feb. 22, 1867	Pollock, Timothy, M.D., F.R.C.S., 26 Hatton-garden, E.C.
Nov. 23, 1866	Potter, G., F.R.M.S., 42 Grove-road, Upper Holloway, N.
June 22, 1866	Powe, I., St. John's, Richmond, Surrey.
May 25, 1866	Powell, Hugh, F.R.M.S., 170 Euston-road, N.W.
June 25, 1869	Powell, Llewellyn, M.R.C.S., 24 Cloudesley-street, Islington, N.
July 7, 1865	Powell, Thomas, 18 Doughty-street, Mecklenberg-square, W.C.
Oct. 26, 1866	Praill, Edward, 39 Mornington-road, N.W.
Dec. 27, 1867	Preston, H. B., 1 Devonshire-road, Liverpool.
June 24, 1870	Preston, Francis W. H., 30 Warwick-gardens, Kensington, W.
Feb. 26, 1869	Prichard, Thomas, M.D., Abbington Abbey, Northampton.
Nov. 27, 1868	Pritchett, Benjamin, 131 Fenchurch-street, E.C.
July 26, 1867	Pritchett, Francis, 131 Fenchurch-street, E.C.
April 23, 1869	Quekett, Arthur Edwin, 13 Delamere-crescent, Westbourne-square, W.
April 23, 1869	Quekett, Alfred J. S., 13, Delamere-crescent, Westbourne-square, W.

Date of Election.	
April 23, 1869	Quekett, Rev. William, The Rectory, Warrington.
Feb. 23, 1866	Quick, George E., 109 Long-lane, Bermondsey, S.E.
Oct. 26, 1866	Rabbits, W. T., Selwood, Mayow-road, Forest-hill, S.E.
Nov. 23, 1866	Radermacher, J. J., 21 Tregunter-road, Boltons, West Brompton, S.W.
Sept. 24, 1869	Radcliffe, J. D., 93 Albion-road, Dalston.
Oct. 26, 1866	Ramsbotham, J. M., M.D., 15 Amwell-street, Pentonville, E.C.
Oct. 26, 1866	Ramsden, Hildebrand, M.A., F.L.S., F.R.M.S., Forest-rise, Walthamstow, N.E.
Aug. 28, 1868	Rance, T. G., Widmore-lane, Bromley, Kent.
May 22, 1868	Rawles, W., 64 Kentish-town-road, N.W.
Dec. 18, 1868	Redl, C. A., 11 Upper Wimpole-street, W.
July 7, 1865	Reeves, W. W., F.R.M.S., 37 Blackheath-hill, Greenwich, S.E.
Oct. 22, 1869	Rendle, J. B., M.D., Park-hill, Clapham-park, S.W.
Mar. 25, 1870	Richardson, Thos. Hyde, Raleigh-lodge, Devonshire-road, Forest-hill.
Jan. 24, 1868	Richardson, C. J., 44 Duncan-terrace, Islington, N.
Dec. 22, 1865	Richardson, C. T., M.D., 36 Dorset-square, N.W.
Feb. 23, 1866	Rixon, F., F.R.M.S., Loats-road, Clapham-park, S.W.
June 25, 1869	Roberts, John H., F.R.C.S., F.R.M.S., 20 New Finchley-road, St. John's-wood, N.W.
May 22, 1868	Rogers, John, Elm Avenue, New Basford, near Nottingham.
Oct. 26, 1866	Rogers, Jos. R., 12 Bellefield-terrace, Bellefield-road, Stockwell, S.W.
Oct. 26, 1866	Rogers, Thomas, Mortlock-house, Loughborough-road, Brixton, S.W.
April 24, 1868	Rogerson, John, F.R.M.S., care of Mr. H. Crouch, 54 London-wall, E.C.
May 22, 1868	Roper, F. C. S., F.L.S., F.G.S., F.R.M.S., 157 Maida-vale, W.
Sept. 28, 1866	Ross, Thomas, F.R.M.S., 7 Wigmore-street, W.

Date of Election.	
July 24, 1868	Rowe, James, jun., M.R.C.V.S., 65 High-street, Marylebone, W,
Oct. 26, 1866	Rowlett, John, 8 Regent-street, S.E.
May 28, 1869	Rowley, W. J., 7 St. John's-terrace, Clerkenwell, E.C.
June 14, 1865	Ruffle, G. W. (*Curator*), 131 Blackfriars-road, S.E.
Mar. 22, 1866	Russell, Rev. F. W., F.R.M.S., Charing Cross Hospital, W.C.
Oct. 27, 1865	Russell, James, 4 Lansdowne-terrace, London-fields, Hackney, N.E.
Oct. 26, 1866	Russell, Joseph, F.R.M.S., Cumberland-lodge, Brixton-hill, S.W.
May 22, 1868	Russell, Thomas D., Patson Villa, Canterbury-road, Brixton, S.W.
Feb. 22, 1867	Rutter, H. Lee, 1 St. Barnabas Villas, Lansdowne-circus, South Lambeth, S.W.
Dec. 17, 1869	Salmon, John, 24 Seymour-street, Euston-square.
Dec. 17, 1869	Sanders, Gilbert, Brockley-on-the-Hill, Monkstown, Dublin.
Nov. 22, 1867	Sanford, John, 30 Willes-road, Kentish-town, N.W.
April 26, 1867	Scadding, H., 9 New Turnstile, Holborn, W.C.
Dec. 18, 1868	Scantlebury, William, 7 Wells-street, Gray's-inn-road, W.C.
May 22, 1867	Scatliff, John Parr, M.D., 132 Sloane-street, S.W.
May 28, 1869	Scoble, Samuel W., 25 James-street, Covent-garden, W.C.
July 27, 1868	Sewell, Richard, Prince's-road, Lambeth, S.E.
July 27, 1866	Sharpey, W., M.D., F.R.S., 33 Woburn-place, W.C.
Oct. 22, 1869	Shaw, Wm. Foster, 71 Greenwood-street, Dalston, N.
Jan. 22, 1869	Sheehy, William H., M.D., 4 Claremont-square, N.
Aug. 23, 1867	Simmons, James J., L.D.S., F.R.M.S., 18 Burton-crescent, W.C.
May 28, 1869	Simonds, Professor J. B., F.R.M.S., Royal Veterinary College, N.
Dec. 28, 1866	Simpson, G. Wharton, 36 Canonbury-park South, N.

Date of Election.	
Mar. 27, 1868	Simson, Thos., The Laurels, Courtyard, Eltham.
May 28, 1869	Sketchley, H. G., 10 Ampthill-square, N.
Dec. 28, 1866	Slade, J., 22 Great Percy-street, Pentonville.
Oct. 23, 1868	Smart, William, 27 Aldgate, E.
May 25, 1866	Smith, Alpheus, 43 Choumert-road, Rye-lane, Peckham.
Mar. 25, 1870	Smith, Francis Lys, 3 Grecian-cottages, Crown-hill, Norwood.
Oct. 26, 1868	Smith, H. Ambrose, 2 King William-street, City, E.C.
June 26, 1868	Smith, James, F.L.S., F.R.M.S., 51 Gibson-square, Islington, N.
May 22, 1868	Smith, James John, F.R.M.S., 56 Tollington-road, N.
April 23, 1869	Smith, Vernon, 37 Tavistock-square, W.C.
June 24, 1870	Smith, William, 1 Down-place, Hammersmith, W.
April 23, 1869	Snartt, T. G., 27 St. Paul's-road, Canonbury, N.
April 24, 1868	Snellgrove, W., 22 Surrey-square, S.E.
Sept. 22, 1865	Southwell, C., 44 Princes-street, Soho, W.
Dec. 18, 1868	Sowerby, D., 38 Albert-road, Dalston, N.E.
May 22, 1868	Spencer, John, Brooks's Bank, 81 Lombard-street, City, E.C.
Dec. 28, 1866	Spicer, Rev. W. W., F.R.M.S., care of the Rev. J. Bramhall, King's Lynn, Norfolk.
Nov. 23, 1866	Spurrell, F. C. J., F.R.M.S., Belvidere, Kent, S.E.
April 22, 1870	Stanley, Wm. Ford, Railway-approach, London-bridge, S.E.
Mar. 24, 1865	Starling, Benjamin, 11 Gray's-inn-square, W.C.
Aug. 24, 1866	Steward, J. H., F.R.M.S., 406 Strand, W.C.
Mar. 19, 1869	Stokes, Frederick, 31 Lincoln's-inn-fields, W.C.
Nov. 26, 1869	Stoker, George Naylor, F.R.M.S., Inland Revenue Office, Somerset-house, W.C.
July 1, 1866	Suffolk, W. T., F.R.M.S., Claremont-lodge, Park-street, Camberwell, S.E.
Nov. 22, 1867	Swainston, J. T., 6 Buckingham Palace-road, S.W.
Nov. 24, 1865	Swansborough, E., 6 Great James-street, Bedford-row, W.C.
June 24, 1870	Swain, Ernest, 89 Ladbroke-road, W.
Dec. 18, 1868	Swift, James, 128 City-road, E.C.

Date of Election.	
June 26, 1868	Syms, F. R., 4 Acacia-villas, Upper Richmond-road, Putney, S.W.
Nov. 22, 1867	Tarner, A. P., F.C.S., 97 High-st., Marylebone, W.
May 22, 1868	Tatem, J. G., Russell-street, Reading.
Dec. 22, 1865	Terry, J., 109 Borough-road, S.E.
May 28, 1869	Thairlwall, F. J., 169 Gloucester-road, Regent's-park, N.W.
July 23, 1869	Thin, James, Ormiston-lodge, Claremont-place, Brixton-road, S.W.
Jan. 24, 1868	Tomkins, Samuel Leith, 26 Buckland-crescent, Belsize-park, N.W.
July 24, 1868	Tulk, John A., M.D., Spring-grove, Isleworth, W.
July 24, 1868	Tulk, John A., F.R.M.S., &c., Firfield, Addlestone, Weybridge.
July 26, 1867	Turnbull, Joseph, 1 Clifton-villas, Highgate-hill, N.
June 25, 1869	Turner, R. D., Chafford, Tunbridge.
Mar. 27, 1868	Tuson, Professor Richard V., Royal Veterinary College, N.W.
July 27, 1866	Veitch, Harry, F.H.S., The Royal Exotic Nursery, King's-road, Chelsea, S.W.
Feb. 23, 1866	Walker, A., M.D., 16 Keppel-street, Russell-square, W.C.
May 28, 1869	Walker, Henry, 100 Fleet-street, E.C.
June 26, 1868	Walker, J. W., Fairfield-house, Watford.
Mar. 22, 1867	Wall, Alfred J., 46 Bessborough-street, Pimlico, S.W.
Dec. 18, 1868	Waller, Arthur, F.R.M.S., 11 Aberdeen-park, Highbury, N.
May 22, 1868	Waller, J. G., 68 Bolsover-street, Portland-rd., W.
Oct. 27, 1865	Wallis, George, South Kensington Museum, S.W.
Aug. 26, 1870	Warburton, Samuel, Merton-villa, New-road, Lower Tooting, S.W.
Nov. 22, 1867	Ward, F. H., Springfield-house, near Tooting, Surrey.

Date of Election.	
Dec. 18, 1868	Warner, Alfred, 93 Dempsey-street, Mile-end, E.
Feb. 26, 1869	Warner, William, 93 Dempsey-street, Mile-end, E.
May 25, 1866	Warrington, H. R., 25 Upper Barnsbury-street, N.
Oct. 27, 1865	Watkins, C. A., 10 Greek-street, Soho, W.
May 22, 1868	Watson, Thos. D., 18A Basinghall-street, E.C.
Sept. 22, 1865	Watson, T. G., 43 Poland-street, Oxford-street, W.
Sept. 25, 1868	Waugh, J. W. Spencer, 4 Maitland-park-villas, Haverstock-hill, N.W.
Dec. 28, 1866	Way, T. E., 65 Wigmore-street, W.
Jan. 22, 1869	Webb, George, Buckhurst-hill, Essex.
May 24, 1867	Weeks, A. W. G., 18 Gunter's-grove, Chelsea, S.W.
May 28, 1869	Welsh, W., 7 Bloomfield-street, W.
Dec. 22, 1865	West, W., 54 Hatton-garden, E.C.
Dec. 28, 1866	Wheldon, W., F.R.M.S., 58 Great Queen-street, W.C.
April 23, 1869	White, Charles Frederick, F.R.M.S., 42 Windsor-road, Ealing.
Oct. 26. 1866	White, F., 1 New-road, Commercial-road-east, E.
Feb. 26, 1868	White, Francis W., 2 Gipsy-hill-villas, Norwood, S. E.
May 22, 1868	White, T. Charters, M.R.C.S., F.R.M.S. (*Secretary*), 32 Belgrave-road, S.W.
May 24, 1867	White, W., F.R.M.S., 14 Park-terrace, Highbury, N.
July 24, 1868	Wight, James F., F.R.M.S., Chesnut-villa, Gipsy-road, Norwood, S.E.
May 22, 1868	Wigner, John M., B.A., B.Sc., 16 Grove Hill-terrace, Grove-lane, Camberwell, S.E.
May 22, 1868	Wild, E. G., 13 College-crescent, Belsize-park, N.W.
Jan. 25, 1867	Willsworth, H., 7 Whittington-terrace, Upper Holloway, N.
Feb. 23, 1866	Wilshin, J., 12 Totford-place, Neckinger, Bermondsey, S.E.
Feb. 22, 1867	Wilson, Frank, 110 Long-acre, W.C.
April 24, 1868	Withall, Henry, 1 The Elms, St. John's-road, Brixton, S.W.
May 28, 1869	Wood, Charles H., F.C.S., 25 Devonshire-road, Holloway, N.
Sept. 22, 1865	Wood, E. G., 74 Cheapside, E.C.
Aug. 27, 1869	Woods, S. Fell, 1 Park-hill, Forest-hill, S.E.

Date of Election.	
Oct. 25, 1867	Worthington, Richard, Champion-park, Denmark-hill, S.E.
Nov. 23, 1866	Wright, Edw., 89 Shepherdess-walk, E.C.
Aug. 4, 1865	Wyatt, C. C., 9 North Audley-street, W.
Oct. 26, 1866	Yeats, Christopher, Mortlake, Surrey, S.W.
April 26, 1867	Young, J. T., 32 Mount-street, New-road, White-chapel, E.

RULES.

I.—That "The Quekett Microscopical Club" hold its meetings at University College, Gower Street, on the fourth Friday Evening in every month, at Eight o'clock precisely, or at such other time or place as the Committee may appoint.

II.—That the business of the Club be conducted by the President, four Vice-Presidents, the Treasurer, the Honorary Secretary, the Honorary Secretary for Foreign Correspondence, and a Committee of twelve other members. Six to form a quorum. That the Editor of the Journal be *ex officio* an additional member of the Committee. That the President, Vice-Presidents, Treasurer, and two Secretaries, with four senior members of the Committee (by election) retire annually, but be eligible for re-election.

III.—That at the ordinary Meeting in June, nominations be made of Candidates to fill the offices of Vice-Presidents and vacancies on the Committee. That such nominations be made by resolutions duly moved and seconded, no Member being entitled to propose more than one Candidate. That in the event of such nominations exceeding one half more than the number of vacant offices, the Candidates be reduced by show of hands to such proportion. That the President, Treasurer, Honorary Secretary, and Honorary Secretary for Foreign Correspondence be nominated by the Committee. That a list of all nominations made as above be printed in alphabetical order upon the ballot paper. That at the Annual General Meeting in July all the above officers be elected by ballot from the candidates named in the lists, but any member is at liberty to substitute on his ballot-paper any other name or names in lieu of those nominated for the offices of President, Treasurer, Honorary Secretary, and Honorary Secretary for Foreign Correspondence.

IV.—That in the absence of the President and Vice-Presidents the Members present at any ordinary Meeting of the Club elect a Chairman for that evening.

V.—That every Candidate for Membership be proposed by two or more Members, who shall sign a certificate (see Appendix) in recommendation of him—one of the proposers from personal knowledge. The certificate shall be read from the chair, and the Candidate therein recommended ballotted for at the following Meeting. Three black balls to exclude.

VI.— That the society include not more than twenty Foreign Honorary Members, elected by the Members by ballot upon the recommendation of the Committee.

VII.—That the Annual Subscription be Ten Shillings, payable in advance on the 1st of July, but that any Member elected in May or June be exempt from subscription until the following July. That any Member desirous of compounding for his future subscription may do so at any time by payment of the sum of Ten Pounds; all such sums to be duly invested in such manner as the Committee shall think fit. That no person be entitled to the full privileges of the Club until his subscription shall have been paid; and that any Member omitting to pay his subscription six months after the same shall have become due (two applications in writing having been made by the Treasurer) shall cease to be a Member of the Club.

VIII.—That the accounts of the Club be audited by two Members, to be appointed at the ordinary Meeting in June.

IX.—That the Annual General meeting be held on the fourth Friday in July, at which the Report of the Committee on the affairs of the Club, and the Balance Sheet duly signed by the Auditors shall be read. Printed lists of Members nominated for election as President, Vice-Presidents, Treasurer, Secretaries, and Members of the Committee having been distributed, and the Chairman having appointed two or more Members to act as Scrutineers, the Meeting shall then proceed to ballot. If from any cause these elections, or any of them, do not take place at this Meeting, they shall be made at the next ordinary Meeting, of the Club.

X.—That at the ordinary Meetings the following business be transacted:—The minutes of the last Meeting shall be read and confirmed; donations to the Club since the last Meeting announced

and exhibited; ballots for new Members taken; papers read and discussed; and certificates for new Members read; after which the Meeting shall resolve itself into a conversazione.

XI.—That any Member may introduce a Visitor at any ordinary meeting, who shall enter his name with that of the Member by whom he is introduced, in a book to be kept for the purpose.

XII.—That no alteration be made in these Laws, except at an Annual General Meeting, or a Special General Meeting called for that purpose; and that notice in writing of any proposed alteration be given to the Committee, and read at the ordinary Meeting at least a month previous to the Annual or Special Meeting, at which the subject of such alteration is to be considered.

APPENDIX.

Quekett Microscopical Club.

Mr.

of

being desirous of becoming a Member of this Club, we beg to recommend him for election.

(*on my personal knowledge*).

This Certificate was read 187

The Ballot will take place 187

RULES FOR THE EXCHANGE OF SLIDES.

I. That all Slides be deposited with the Exchange Committee.

II. That not more than two similar Slides be placed in the Exchange Box at one time by any one Member.

III. That the Slides be classified by the Committee into Sections, numbered according to quality.

IV. Members to select from the class in which their Slides are placed, at the ordinary meeting of the Club.

V. Members may leave the selection to the Exchange Committee, if they prefer it.

VI. Slides once exchanged cannot be exchanged again.

VII. A Register shall be kept, in which the Slides deposited shall be entered and numbered, with the date of receipt, and in which exchanges shall also be noted.

VIII.—All expenses incurred in the transmission of Slides or in correspondence respecting them, to be borne by the Member on whose account such charges may be incurred.

Parcels may be addressed—

Mr. T. Charters White,
192, Piccadilly,
London, W.
[Exchange.]

Note.—As much inconvenience frequently arises from the breakage of Slides in transmission through the Post, the following method is recommended:—Pack the Slides in a small wooden box, which can be obtained of any Optician, tie it securely with string and attach a slip of parchment to one end, sufficiently large to receive the Postage Stamps, Address, and local Post-office Stamps during transmission.

If paper be used as a wrapper to the box, the colour should be *black*.

When twelve or more Slides are sent, they should be packed in a racked box and forwarded by Railway.

MEETINGS

OF THE

QUEKETT MICROSCOPICAL CLUB,

AT

UNIVERSITY COLLEGE, GOWER STREET, LONDON.

1870.—August		12	26
	September	9	23
	October	14	28
	November	11	25
	December	9	23
1871.—January		13	27
	February	10	24
	March	10	24
	April	14	28
	May	12	26
	June	9	23

The Ordinary Meetings will be held on the fourth Friday Evenings, at Eight o'clock.

Extra Meetings for Conversation and Exhibition of Objects only, will be held on the second Friday of every month, at 7 o'clock.

The Annual General Meeting July 28th, 1871, at Eight o'clock.

Offices, 192, Piccadilly.

Q. M. C.

EXCURSIONS, 1870.

April 2nd	WANDSWORTH COMMON. To meet at Clapham Junction, at 3 o'clock.
April 16th	BARNES. To meet at Waterloo Station (Richmond line).
April 30th	WIMBLEDON. To meet at Waterloo Station (main line).
May 14th	CARSHALTON. To meet at London Bridge Station (S. Lond. line).
May 28th	CHISELHURST. To meet at Charing Cross Station.
June 11th	ELSTREE. To meet at St. Pancras Station, at 1.30 p.m.
June 23rd	EXCURSIONISTS' ANNUAL DINNER. Arrangements will be duly announced.
June 25th	HAMPTON COURT. To meet at Waterloo Station (main line).
July 9th	BARNET (for TOTTERIDGE). To meet at King's Cross Station.
July 23rd	BROMLEY (for KESTON). To meet at Ludgate Hill Station.
Aug. 6th	THAMES DITTON. To meet at Waterloo Station (main line).
Aug. 20th	GRAYS. To meet at Fenchurch Street Station.
Sept. 3rd	EAST END (for FINCHLEY). To meet at King's Cross Station.
Sept. 17th	SNARESBROOK. To meet at Fenchurch Street Station.
Oct. 1st	VICTORIA DOCKS. To meet at Fenchurch Street Station.
Oct. 8th	HOMERTON (for HACKNEY MARSHES). To meet at Broad Street Station.

The time of departure from Town, unless otherwise specified, will be THE FIRST TRAIN AFTER TWO O'CLOCK.

W. J. de L. Arnold,
F. W. Gay,
W. W. Reeves,
W. T. Suffolk,
} Excursion Committee.

W. DAVY AND SON, PRINTERS, GILBERT STREET, W.

SIXTH REPORT

OF THE

QUEKETT MICROSCOPICAL CLUB,

AND

LIST OF MEMBERS.

Meeting at University College, London, on the Second and Fourth Fridays of every Month at Eight o'clock.

Offices: 192, PICCADILLY,
LONDON.

July 1871.

(*Extract from original Prospectus, July* 1865.)

" The want of such a Club as the present has long been felt, wherein " Microscopists and students with kindred tastes might meet at stated periods " to hold cheerful converse with each other, exhibit and exchange specimens, " read papers on topics of interest, discuss doubtful points, compare notes of " progress, and gossip over those special subjects in which they are more or " less interested: where, in fact, each member would be solicited to bring his " own individual experience, be it ever so small, and cast it into the treasury " for the general good. Such are some of the objects which the present Club " seeks to attain. In addition thereto it hopes to organize occasional Field " Excursions, at proper seasons, for the collection of living specimens, to " acquire a Library of such books of reference as will be most useful to " enquiring students; and, trusting to the proverbial liberality of Micro-" scopists, to add thereto a comprehensive Cabinet of Objects. By these, and " similar means, the Quekett Microscopical Club seeks to merit the support " of all earnest men who may be devoted to such pursuits; and, by fostering " and encouraging a love for Microscopical studies, to deserve the approval " of men of science and more learned societies."

OFFICERS AND COMMITTEE.

(Elected July 1871.)

President.

PROFESSOR LIONEL S. BEALE, M.B., F.R.S., F.R.M.S.

Vice-Presidents.

ROBERT BRAITHWAITE, M.D., F.L.S., F.R.M.S.
ARTHUR E. DURHAM, F.R.C.S., F.R.M.S.
CHAS. J. LEAF, F.L.S., F.R.M.S.
HENRY LEE, F.L.S., F.R.M.S.

Treasurer.

ROBERT HARDWICKE, F.L.S.

Hon. Secretary.

T. CHARTERS WHITE, M.R.C.S., F.R.M.S.

Hon. Secretary for Foreign Correspondence.

M. C. COOKE, M.A.

Hon. Reporter.

R. T. LEWIS, F.R.M.S.

Committee.

S. J. MCINTIRE, F.R.M.S.
B. T. LOWNE, M.R.C.S.
T. CROOK, F.R.M.S.
J. MATTHEWS, M.D.
W. ALLBON, F.R.M.S.
T. W. BURR, F.R.A.S.
W. M. BYWATER, F.R.M.S.
CHARLES F. WHITE, F.R.M.S.
W. H. GOLDING.
T. GREENISH, F.R.M.S.
W. T. LOY, F.R.M.S.
E. MARKS.

Librarian.

EDWARD JAQUES, F.R.M.S.

Curator.

G. W. RUFFLE.

Excursion Committee.

F. W. GAY, F.R.M.S.
W. W. REEVES, F.R.M.S.
W. T. SUFFOLK, F.R.M.S.
F. OXLEY.

Exchange (of Slides) Committee.

H. F. HAILES. W. HISLOP. E. MARKS.

PAST PRESIDENTS.

	Elected
EDWIN LANKESTER, M.D., F.R.S. - - -	July, 1865.
ERNEST HART - - - - - - -	„ 1866.
ARTHUR E. DURHAM, F.L.S., &c. - - -	„ 1867.
„ „ - - - -	„ 1868.
PETER LE NEVE FOSTER, M.A. - - - -	„ 1869.
LIONEL S. BEALE, M.B., F.R.S., &c. - - -	„ 1870.

REPORT OF THE COMMITTEE.

THE period has again arrived when the Committee of the Quekett Microscopical Club usually render to their constituents an Annual Statement of the progress and prospects of the Club.

In presenting their Sixth Annual Report, the Committee have much pleasure in announcing that the Club is still attended by the prosperity and success which marked its early career, and whether they regard the progress of the Club by the light of work accomplished, by the increase in its members arising from the influx of new members, or by the warm and cordial manner in which the members, individually and collectively, are carrying out the objects for which the Club was established, the Committee feel that in offering their congratulations, they can do so in the firm assurance that they are based on no uncertain foundation.

To rightly estimate this progress, it is necessary to recall to mind the objects sought to be promoted by the Club, and then to see how these have been fulfilled during the past year.

The primary objects the founders of the Club had in view in its formation may be gathered from the extract from the

original prospectus accompanying this Report, and may thus be summarised : "That Microscopists and others of kindred tastes might meet at stated periods to converse with each other, and exhibit and exchange specimens—to organise Field Excursions—to form a Library of Books of Reference and Study, and a Cabinet of Microscopic Objects for the use of enquiring students."

Your Committee, therefore, desire to lay before the members of the Club a report of what has been done in these several departments since the last annual meeting.

By the continued kindness of the authorities of University College, the Club still enjoys the favour of meeting within its walls twice each month throughout the year, and the Committee beg here to acknowledge and publicly thank them for what is warmly appreciated as a privilege of inestimable advantage.

These meetings have been more than usually well attended during the last year, and many objects of Microscopical beauty and interest have been exhibited to the pleasure and edification of those present; and while your Committee would not say a word in disparagement of the benefits derivable from the ordinary meetings, they would still urge upon the members and especially the younger and inexperienced in the use of the Microscope, the peculiar advantages supplied by the gossip nights on the *second* Friday in each month, for at these meetings mutual assistance and instruction is rendered to all. By a reference to the list of papers read before the Club at the ordinary meetings, it will be seen that although Microscopy may be the chief end sought to be furthered by the Club, yet the members neglect no opportunity of working at those collateral branches of science which may aid in promoting it. In addition to these papers many

casual communications on points of Microscopical interest have been brought before the Club at its ordinary meetings from time to time, and if they are not more especially reported on here it is not that they are considered deficient in profit or interest, or deemed less valuable than papers, but because they will be found recorded in the Transactions and Proceedings of the Club, issued to its members every quarter.

The Annual Conversazione of the Club was, by kind permission, held at University College, on Friday Evening, March 17th, and was attended by over 1,100 members and visitors, and the Committee desire to thank those members and others who kindly contributed to render this occasion a source of satisfaction and pleasure to those who attended it.

The fortnightly Field Excursions of the Club during the summer months have been, and continue to be, well attended, and have proved fertile sources of information and healthful recreation to those who take part in them, as well as a means of fostering that friendship and kindly feeling which are the distinguishing features of the Club.

By the liberality of the members and others, the Slides in the Cabinet continue to increase in number. The following have been contributed since the last annual meeting :

Mr. Chas. Adcock . . .	25
Rev. J. Bramhall . . .	5
Mr. L. Bennett . . .	2
,, A. C. Cole . . .	32
,, C. Collins	1
,, M. C. Cooke	100
,, T. Curties	12
,, J. W. Groves . . .	6
Dr. W. J. Gray	3

Mr. Hailes	12
„ Hainworth	6
„ L. Hardman	18
„ T. Hennah	3
„ B. D. Jackson	4
„ F. Kitton	6
„ R. T. Lewis	3
Dr. Lowe	2
Mr. F. Marshall	6
„ F. Oxley	11
„ J. F. Pickard	6
„ G. E. Quick	37
„ T. Rogers	3
„ Alpheus Smith	3
„ Tatem	1
„ Waller	6
„ T. C. White	24
The Fibre Committee	37
The Bury Collection of Polycystinæ by purchase	122
	496
Previous Donations . . .	1430
In the Cabinets . . .	1926

Your Committee hope shortly to complete arrangements whereby they will be enabled to issue a catalogue of the Slides, and thus promote their extended use among the members; and while the increase in the number of Slides presented to the Cabinet during the past year is a gratifying indication of the interest felt by the members in carrying out this department of the Club's operations, the Committee would press upon their attention the desirability of still further contributing to render the Quekett Cabinet even yet

more complete and comprehensive by presenting duplicate Slides whenever mounting subjects for themselves.

During the past year considerable additions have been made to the Library of the Club, by the liberal donations of Books from the President and Members. The following is a list of the volumes presented since the last meeting, exclusive of pamphlets and serial publications:

H. Eley's Geology in the Garden	*The late Mr. J. Bockett.*
Tyneside Naturalist Field Club (Transactions)...	*Mr. W. M. Bywater.*
Dr. Carpenter's Microscope and its Revelations. 2nd Edit.	*Dr. Ramsbotham.*
H. Baker's Microscope made easy	*Mr. T. C. White.*
Dr. Carpenter's Vegetable Physiology	*Mr. J. W. Groves.*
Nicholson's Manual of Zoology	*do.*
The Microscope; its History and Construction, by JABEZ HOGG. 1st Edit.	*Mr. M. C. Cooke.*
Pritchard's History of Infusoria. 1st Edit.	*do.*
Handbook of British Fungi, by M. C. COOKE ...	*Mr. G. E. Quick.*
Land and Freshwater Shells, by T. GIBSON	*The Author.*
Sir D. Brewster's Treatise on the Microscope ...	*Mr. M. C. Cooke.*
Synopsis of British Seaweeds, compiled from Professor Harvey's Phycologia Brittanica...	*Mr. Jno. Michels.*
Illustrations of the Salts of Urine, &c. 2nd Edit. By Dr. L. S. BEALE	*The Author.*
Protoplasm; or Life, Matter and Mind, by Dr. BEALE	*do.*
On the Structure and Growth of the Tissues, by Dr. BEALE	*do.*
Kidney Diseases, Urinary Deposits and Calculous Disorders, &c., by Dr. BEALE	*do.*
Disease Germs; their Real Nature, by Dr. BEALE	*do.*
Disease Germs; their Supposed Nature, by Dr. BEALE	*do.*
Saturday Afternoon Rambles, by HY. WALKER	*The Author.*

As the circulation of the Books of the Club is much appreciated, your Committee contemplate printing a catalogue of

them, and intend to issue the books twice a month instead of only on the ordinary meetings as at present, thus making them more generally available for the use of the members.

The Committee desire to congratulate the Club upon the continued increase in the number of its members. Since the last annual meeting 76 new members have been elected; and though by deaths and resignations they have to regret the loss of 27 members, yet they see in the number now on the books, amounting to 550, a cause for much congratulation, inasmuch as it is an indication that the Club is supplying the wants of that rapidly increasing section of the public who are awakening to the interest of Microscopical research, and especially of those who are comparative beginners and needing that assistance it is the characteristic of this Club to afford. While referring to the number of the members, your Committee cannot conclude without a special reference to the loss the Club, in common with all lovers of Microscopical science, has sustained by the deaths of Mr. Wm. Arnold, one of the oldest supporters of the Club; of Mr. John Bockett, the designer of the lamp named after him; and of Mr. Thos. Ross, whose excellent work as an optician has given him a world-wide fame, and whose decease must be accompanied by almost universal regret. The Committee desire to bear their unanimous testimony to the warm interest always felt by these gentlemen in all things concerning the welfare of the Club, and the deep regret they now feel in having to record their decease.

The Committee cannot close this Annual Report without expressing their thanks to Mr. Richard T. Lewis, for his valuable and much appreciated assistance as their Honorary Reporter, to Mr. Edward Jaques, their Honorary Librarian, and to Mr. G. W. Ruffle, the Honorary Curator, also to Messrs. Gay, Oxley, Reeves and Suffolk, the Excursion

Committee, and to Messrs. Hailes, Hislop and Marks, the Exchange of Slides Committee, and to acknowledge the very efficient manner in which they carry out the duties of their several departments, and the readiness they also evince in helping the Committee in various other ways.

Looking back at the prospect afforded by the year that is now past, your Committee feel every reason for satisfaction, and are full of hope that the future of the Club will be marked by good and useful work, and they desire to conclude by recommending to the attention of the members generally the desirability of a systematic pursuit of the various branches of Microscopical study, without which the Microscope merely becomes an interesting amusement, and not a means of promoting the advancement of scientific truth.

July 28th, 1871.

PAPERS READ DURING THE YEAR.

Mr. S. J. McIntire -	On Polyxenus Lagurus.
,, T. C. White -	,, Papers for the Club.
,, Thomas Curties	,, Eggs of Bird Parasites in Zoological Gardens.
,, M. C. Cooke -	,, read a communication from New York on Pleurosigma.
,, B. T. Lowne -	,, on so-called Spontaneous Generation.
,, J. Slade - - -	,, Microscopic characters of Cannel Coal.
,, John Hopkinson -	,, Dicranograptus.
,, William Ackland	,, New Selenite Stage.
Dr. L. S. Beale -	,, gave a demonstration in Microscopical injecting.
Mr. T. C. White - -	,, On a new method of making sections of hard tissues.
,, M. C. Cooke - -	,, read a paper by Mr. F. Kitton on the Diatoms of the Morz deposit of Jutland.
,, J, R. Leifchild -	,, On Fossil Wood.
,, W. H. Furlonge	,, Minute Anatomy of Pulex irritans.
,, John Hopkinson	,, Diplograpsus pristis.
,, B. T. Lowne - -	,, Leucocytes.
,, B. D. Jackson -	,, A description of Dr. Barker's new paraboloid.
,, N. E. Green -	., On Diatom markings, as examined by the Oxycalcium Light.

TREASURER'S REPORT.

JUNE 30TH, 1871.

RECEIPTS.	£	s.	d.	PAYMENTS.	£	s.	d.
By Balance brought forward	26	9	0	Printing and Stationery	28	11	0
Subscriptions	225	1	6	Postages	17	8	9
Sales of Journal and Advertisements	18	18	1	Advertisements	0	11	0
Interest on Deposit Note at City Bank	0	2	4	Attendance	10	15	0
				Petty Expenses	17	19	11
				Journal	87	3	1
				Soirée Expenses	48	3	0
				Property Purchased	23	5	10
				Balance at Bank	36	13	1
	£270	10	11		£270	10	11

We, the undersigned, having examined the above statement of Income and Expenditure, and the Vouchers referring thereto, hereby certify that the said Account is correct.

W. T. SUFFOLK,
EDWARD MARKS, } *Auditors.*

HONORARY FOREIGN MEMBERS.

Date of Election.	
Oct. 25, 1867	Guiseppe de Notaris, *Professor of Botany, &c., &c.,* Genoa.
Jan. 24, 1868	Arthur Meade Edwards, M.D., 314 West Thirty-fourth-street, New York.
Mar. 19, 1869	Rev. E. C. Bolles (*Ex-President of the Portland Society of Natural History*), Brooklyn, New York.
Mar. 19, 1869	Alphonse de Brebisson (*Author of numerous contributions on the Desmidiaceæ and Diatomaceæ*), Falaise, Normandy, France.

LIST OF MEMBERS.

Date of Election.	
Sept. 24, 1869	Ackland, William, 122 Newgate-street, E.C.
April 22, 1870	Adams, William, F.R.C.S., 37 Harrington-square, N.W.
Nov. 27, 1868	Adkins, William, 270 Oxford-street, W.
Oct. 27, 1865	Aldous, W. Lens, 47 Liverpool-street, W.C.
Mar. 23, 1866	Allbon, W., F.R.M.S., 525 New Oxford-street, W.C.
Jan. 22, 1869	Allder, J. R., 5 Suffolk-street, Rotherfield-street, Islington, N.
Oct. 28, 1870	Allen, Rev. Francis H., Warwick Villa, New Hampton, Surrey.
Sept. 27, 1867	Allen, John T., 57 Cross-street, Islington, N.
July 23, 1869	Allen, W. H., C.E., 2 Abingdon-villas, Kensington, W.
Dec. 17, 1869	Ames, George Acland, Union Club, Trafalgar-square, S.W.
Sept. 25, 1868	Andrew, Arthur R., 3 Neville-terrace, Fulham-road, S.W.
Dec. 22, 1865	Andrew, F. W., 3 Neville-terrace, Fulham-road, S.W.
Sept. 22, 1865	Annett, James, Hampton, S.W.
July 7, 1856	Archer, J. A., 172 Strand, W.C.
Dec. 18, 1868	Ashby, John, Staines.
Dec. 23, 1870	Atkinson, Robert Wm., Royal School of Mines, S.W.
Dec. 22, 1865	Atkinson, John, 54 Brook-street, W.
Feb. 26, 1869	Atkinson, William, F.L.S., 47 Gordon-square, W.C.
Mar. 27, 1868	Aubert, Alfred, Lloyds, E.C.

Date of Election.	
Nov. 25, 1870	Baber, Edward Cresswell, 34 Thurloe-square, S.W.
May 22, 1868	Bailey, Capt. L. C., R.N., F.R.G.S., R.A.S., Topographical Dept., New-st., Spring-gardens, S.W.
July 26, 1867	Bailey, George H., M.R.C.S., 25 Charles-street, Middlesex Hospital, W.
Dec. 27, 1867	Bailey, John W., 162 Fenchurch-street, E.C.
April 24, 1868	Baker, Charles, F.R.M.S., 244 High Holborn, W.C.
May 26, 1871	Balshaw, Rev. Robert, 55 Bessborough Gardens, S.W.
Mar. 24, 1871	Baly, Charles, 75 Margaret-street, W.
Aug. 23, 1867	Bannister, Richard, F.R.M.S., The Laboratory, Somerset-house, W.C.
Jan. 26, 1866	Barber, John, F.R.M.S., 29 Brunswick-gardens, W.
Nov. 23, 1866	Barnes, Capt. E., York.
Nov. 25, 1870	Barnes, Herbert J., 2 Richmond-villas, Union-rd., Highbury, N.
April 22, 1870	Barnes, Charles Barritt, 66 Old Broad-street, E.C.
June 23, 1871	Bartlett, Wm. P., 2A Eastbourne-terrace, W.
Oct. 27, 1865	Barratt, T. J., 91 Great Russell-street, W.C.
June 24, 1870	BEALE, LIONEL S., M.B., F.R.S. (*President*), 61 Grosvenor-street, W.
June 25, 1869	Beale, Charles J., Box 110, Post Office, Toronto, Canada.
Dec. 27, 1867	Bealey, Adam, M.D., Oak Lea, Harrogate.
May 28, 1869	Bean, Charles E., Brooklyn-house, Goldhawk-road, Shepherd's Bush, W.
Oct. 26, 1866	Beck, Joseph, F.R.M.S., 31 Cornhill, E.C.
May 26, 1871	Bedwell, Fras. Alfred, M.A., Cantab., 3 Old Square, Lincoln's Inn, W.C.
Aug. 23, 1867	Bell, James, F.R.M.S., The Laboratory, Somerset-house, W.C.
Mar. 19, 1869	Bennett, L., 30 Gloucester-street, Pimlico, S.W.
Mar. 24, 1871	Bentley, Algernon Royds, 9 Portland-place, W.
Dec. 27, 1867	Bentley, C. S., Hazellville Villa, Sunnyside-road, Hornsey-rise, N.
May 22, 1868	Berney, John, F.R.M.S., 61 North-end, Croydon.
Oct. 23, 1868	Bevington, W. A., F.R.M.S., 113 Grange-road, S.E.
Mar. 27, 1868	Bidlake, J. P., B.A., F.C.P., F.C.S., F.R.M.S., 318 Essex-road, N.

Date of Election.	
June 24, 1870	Birch, A. E., 47 Halliford-street, Islington, N.
Jan. 25, 1867	Bird, Peter Hinckes, M.D., 1 Norfolk-square, Hyde-park, W.
Oct. 28, 1870	Bird, C. H. Golding, B.A., Lond., 23 Brunswick-square, W.C.
July 28, 1871	Bishop, Wm., 23A, Hungerford-road, N.
April 22, 1870	Black, William, Abchurch-house, Sherborne-lane, E.C.
Nov. 22, 1867	Blake, F. W., 5 Serle-street, Lincoln's-inn, W.C.
Feb. 23, 1866	Blake, T., 6 Charlotte-terrace, Brook-green, Hammersmith, W.
Mar. 19, 1869	Blankley, Frederick, F.R.M.S., 23 Belitha-villas, Barnsbury, N.
Mar. 19, 1869	Blight, Rev. R., The Vicarage, Bredwardine, Hereford.
April 24, 1868	Bodkin, W. P., Merton-lane, Highgate-rise, N.
June 25, 1869	Bond, George, 11 St. Thomas'-place, Hackney, N.E.
April 22, 1870	Bossy, Alfred Horsley, Prospect Cottages, Stoke Newington, N.
Nov. 27, 1868	Boustead, James, Stourfield Lodge, Effra-road, Brixton, S.E.
Mar. 27, 1868	Bowing, John, 6 Bowater-crescent, Woolwich, S.E.
July 23, 1869	Boyer, Richard, 20 Park-terrace, Highbury, N.
Oct. 23, 1868	Brabham, T., 61 Castle-st., Leicester-square, W.C.
Dec. 22, 1865	Brain, T., 1 Upper Vernon-street, Lloyd-sq., W.C.
Oct. 27, 1865	BRAITHWAITE, R., M.D., M.R.C.S.E., F.L.S., F.R.M.S. (*Vice-President*), The Ferns, Clapham-rise, S.W.
Nov. 24, 1865	Breese, C. J., F.R.M.S., The Ferns, Lyonsdown-road, New Barnet.
June 26, 1868	Briggs, H. B., 36½ Upper Thames-street, E.C.
May 27, 1870	Brigham, H. G., St. George's Hospital, S.W.
Mar. 22, 1867	Brightween, G., 8 Finch-lane, E.C.
Jan. 22, 1869	Brookes, William, 380 Camden-road, Holloway, N.
May 27, 1870	Brown, George Dransfield, M.R.C.S., Uxbridge-road, Ealing, W.
Dec. 28, 1866	Brown, W., 203 Great Portland-street, W.
May 22, 1868	Brown, W. J., 37 Penshurst-road, South Hackney, E.

Date of Election.	
May 26, 1871	Browne, George, 80 Pratt-street, Camden-town, N.W.
May 24, 1867	Browne, H., 40 Camden-square, N.W.
May 25, 1866	Buchanan, A., 382 Camden-road, N.
June 23, 1871	Bucknall, Cedric, 1 Stamford-hill-grove, East Upper Clapton, E.
Jan. 28, 1870	Bull, William J., M.A., Harrow.
Mar. 15, 1870	Burckhardt, Edmund, 105 Gaisford-street, Kentish-town, N.W.
Sept. 28, 1866	Burgess, J. W., 329 Hackney-road, N.E.
Feb. 23, 1866	Burgess, N., 329 Hackney-road, N.E.
June 25, 1869	Burgess, W. F., Guy's Hospital, S.E.
Aug. 26, 1870	Burgess, Martin, 3 Mount Pleasant-terrace, Upper Lewisham-road, S.E.
April 24, 1868	Burr, T. W., F.R.A.S., F.C.S., F.R.M.S., 15 Tibberton-square, N.
Oct. 23, 1868	Burrows, C. R. N., Wanstead, Essex, N.E.
April 24, 1868	Burrows, John, Wanstead, N.E.
Mar. 27, 1868	Burrows, J. Nelson, The Grove, Wanstead, N.E.
June 14, 1865	Bywater, Witham M., F.R.M.S., 5 Hanover-square, W.
July 27, 1866	Bywater, W. M., jun., 5 Hanover-square, W.
May 24, 1867	Callaghan, James, 12 Coal-yard, W.C.
Aug. 23, 1867	Cameron, J., The Laboratory, Somerset-house, W.C.
Sept. 25, 1868	Capel, Charles C., Little Blake Hall, Wanstead, Essex.
May 26, 1871	Catchpole, Robert, 101 Lancaster-road, Notting-hill, W.
Dec. 27, 1867	Chapman, W. C., 39 Granville-square, W.C.
Nov. 26, 1869	Chater, E. M., Watford, Herts.
Sept. 23, 1870	Cheverton, George, High-street, Tunbridge Wells.
July 28, 1871	Clark, Fred. Cheesman, Farnham-house, Morland-road, Croydon.
Mar. 22, 1867	Clover, Jos. T., 3 Cavendish-place, Cavendish-square, W.
May 26, 1871	Coales, Dr. R., 119 Gower-street, W.C.

Date of Election.	
May 22, 1868	Cocks, W. G., 18 Kent-villas, Grange-road-east, Dalston, N.E.
Dec. 10, 1868	Coe, W. E., 31 Gaisford-street, Kentish-town-road, N.W.
May 28, 1869	Cole, Walter B., 17 Mary-street, Weymouth.
Jan. 25, 1867	Coles, Ferdinand, A.P.S., 248 King's-road, Chelsea, S.W.
April 23, 1869	Collings, Thomas P., 38 Surrey-street, Strand, W.C.
July 7, 1865	Collins, C., F.R.M.S., 77 Great Titchfield-street, W.
May 22, 1868	Collins, James, Pharmaceutical Society, Bloomsbury-square, W.C.
Mar. 19, 1869	Conder, Geo., Plough-court, Lombard-street, E.C.
Sept. 23, 1870	Connor, Rochfort, 9 St. Martin's-road, Stockwell, S.W.
Mar. 19, 1869	Cooke, Geo. E., 1 Loddiges-terrace, Hackney, N.E.
June 14, 1865	Cooke, M. C. (*Sect. for Foreign Correspondence*), 2 Grosvenor-villas, Junction-rd., Upper Holloway, N.
Feb. 22, 1867	Cooper, Frank W., L.R.C.S. Edin., Leytonstone, N.E.
Mar. 23, 1869	Coppock, C., F.M.S., F.M.R.S., 31 Cornhill, E.C.
Dec. 17, 1869	Coppock, Jones Henry, Bridport, Dorset.
May 28, 1869	Cottam, Arthur, F.R.A.S., Office of Woods, Whitehall, S.W.
Aug. 28, 1868	Cousens, John, Grove-road, Wanstead, N.E.
July 23, 1869	Creer, Edwin A. O., 2 Albany-place, Commercial-road East, E.
Aug. 4, 1865	Cresy, E., Metropolitan Board of Works, Spring-gardens, S.W.
Aug. 28, 1868	Crisp, Frank, 134 Adelaide-road, N.W.
Dec. 23, 1870	Crisp, John S., 62 Camberwell-road, S.E.
Feb. 27, 1868	Crook, Thomas, F.R.M.S., Grosvenor-villa, Cleveland-road, Surbiton, S.W.
Oct. 26, 1866	Crookes, Wm., F.R.S., 20, Mornington-road, N.W.
July 7, 1865	Crosbie, J. J., 11 Grange-road, Canonbury, N.
July 26, 1867	Cross, R., M.D., 21 New-st., Spring-gardens, S.W.
Sept. 28, 1866	Crouch, Henry, F.R.M.S., 54 London-wall, E.C.
Mar. 27, 1868	Cubitt, Charles, F.R.M.S., 3 Great George-street, Westminster, S.W.

Date of Election.	
May 25, 1866	Curties, T., F.R.M.S., 244 High Holborn, W.C.
June 25, 1868	Darnley, D. Rowland, 12 John-street, Bedford-row, W.C.
June 23, 1871	D'Aubney, Thos., Shepherdess-walk, Hoxton, N.
April 27, 1866	Davis, S., 11 Priory-road, South Lambeth, S.W.
Oct. 22, 1869	Davis, Henry, 19 Warwick-street, Leamington.
Dec. 23, 1870	Dawson, George M., Royal School of Mines, S.W.
May 25, 1866	Dawson, J. E., F.R.M.S., Oak Lodge, Park-road, Watford.
May 22, 1868	Dean, G. A. H., Elmwood, Catford-bridge, Kent, S.E.
Jan. 22, 1869	Deed, Alfred, 4 Eton-villas, Haverstock-hill, N.W.
Nov. 27, 1868	Delferier, Wm., F.R.M.S., 40 Sloane-square, S.W.
April 23, 1869	Delferier, Arthur, 40 Sloane-square, S.W.
Feb. 27, 1868	Dempsey, Joseph M., M.D., F.R.M.S., 27 Charter-house-square, E.C.
July 23, 1869	Devenish, Samuel, 2 Champion-grove, Denmark-hill, S.E.
June 26, 1868	Dickens, Charles, Latimer-house, Hadley, Middlesex.
Feb. 25, 1870	Diss, William Jas., 17 Spurstowe-road, Amherst-road, Hackney, N.E.
Dec. 22, 1865	Dix, James, 26 Pentonville-road, N.
Nov. 24, 1865	Dobson, H. H., F.R.M.S., Pelham Lodge, Alexandra-road, St. John's-wood, N.W.
Jan. 25, 1867	Dodd, Josiah E., 11 Margaret-street, Cavendish-square, W.
Sept. 23, 1870	Dolamore, William, 30 Regent-street, S.W.
Aug. 28, 1868	Donaldson, Alexander L., 14 Wigmore-street, W.
Nov. 27, 1868	Douglas, Rev. R. C., Manaton Rectory, Moreton-hampstead, Exeter.
Jan. 28, 1870	Dowson, Edward, M.D., F.R.M.S., 117 Park-st., Grosvenor-square, W.
Dec. 27, 1867	Draper, E. T., F.R.M.S., Harringay-park, Hornsey, N.
May 22, 1868	Dresser, W. G., 68 Westbourne-road-north, Barnsbury, N.

Date of Election.	
July 28, 1871	Drew, G. C., Milton-house, Cassland-road, South Hackney.
Dec. 23, 1870	Duck, William A., 43 St. George's-road, Southwark, S.E.
Sept. 22, 1865	DURHAM, ARTHUR E., F.L.S., F.R.M.S. 82 Brook-street, Grosvenor-square, W.
Nov. 23, 1866	Durham, F., 14 St. Thomas-street, Borough, S.E.
Aug. 26, 1868	Duer, Y., Cleygate, near Esher, Surrey.
Sept. 25, 1868	Eddy, James Ray, F.R.M.S., F.G.S., Carleton-grange, Skipton, Yorkshire.
Jan. 28, 1870	Edmonds, F. L., 2 York-street, St. James's, S.W.
June 28, 1867	Edmonds, R., 178 Burrage-road, Plumstead, S.E.
July 26, 1867	Eldridge, John R., 19 Downshire-hill, Hampstead, N.W,
July 27, 1865	Emery, J. J., 99 St. George's-road, Southwark, S.E.
May 26, 1871	Enock, Frederick, 48 Tollington-road, Holloway, N.
Sept. 24, 1869	Epps, Richard, M.R.C.S., 89 Great Russell-street, Bloomsbury.
May 28, 1869	Evans, Edward, 12 Surrey-villas, Norwood, S.E.
Feb. 26, 1869	Evans, Fredk., 51 Malpas-road, New-cross, S.E.
Dec. 18, 1868	Eyre, Samuel, 140 South Lambeth-road, S.W.
May 28, 1869	Farmer, Richard, F.R.M.S., F.G.S., Hornsey, N.
Dec. 18, 1868	Farmer, Robert J., 5 Great Turnstile, Holborn, W.C.
Nov. 23, 1866	Fawn, George, 19 Alexandra-road, St. John's-wood, N.W.
Mar. 27, 1868	Field, James, High-street, Highgate, N.
July 26, 1867	Fitch, Frederick, F.R.G.S., F.R.M.S., Hadleigh-house, Highbury New-park, N.
May 22, 1868	Ford, W. B., Claremont-cottage, Colney-hatch-road, Wood-green.
Jan. 27, 1871	Forshaw, Thos., Jun., the Bower, Bowden, Altrincham, Cheshire.

Date of Election.	
Aug. 4, 1865	Foster, P. Le Neve, M.A. (*Vice-President*), Society of Arts, Adelphi, W.C.
Aug. 24, 1866	Foster, P., F.L.S., Belsize-lane, Hampstead, N.W.
April 22, 1870	Foster, John, 213 Regent-street, W.
Mar. 24, 1871	Foulerton, Dr. J., Thatched-house Club, Saint James's-street, S.W.
Oct. 22, 1869	Fox, Charles James, M.R.C.S., 27 Mortimer-street, W.
Dec. 28, 1866	Fox, C. J., F.R.M.S., 16 Cork-street, Bond-street, W.
June 23, 1871	Freeman, Henry E., 10 Durnford-road-east, Holloway, N.
May 26, 1871	Freshwater, Thos. E., 2 Charlotte-street, Caledonian-road, N.
Feb. 26, 1869	Fricker, C. J., 4 Weston-hill-terrace, Upper Norwood, S.E.
June 26, 1868	Fry, Rev. James, M.A., South-grove-house, Tonbridge-wells.
May 22, 1868	Fryer, G. Henry, F.R.M.S., 13 West Abbey-road, St. John's-wood, N.W.
May 28, 1869	Fryer, G. H., 22, North-road, Clapham-park, S.W.
Oct. 26, 1868	Furlonge, W. H., 4 Oxford-road, Hammersmith, W.
July 28, 1871	Furneaux, John Richard, Boxgrove-house, Mayow-park, Forest-hill, S.
Nov. 25, 1870	Fyfe, Andrew, M.D., 42 Montpelier-square, S.W.
Mar. 19, 1869	Gann, James W., 171 Fenchurch-street, E.C.
Mar. 25, 1870	Garden, Robert Spring, 42 Carlton-hill, St. John's-wood, N. W.
May 25, 1866	Gardiner, G., 244 High Holborn, W.C.
April 24, 1868	Garnham, John, F.R.M.S., 123 Bunhill-row, E.C.
July 7, 1865	Gay, F. W., F.R.M.S., 113 High Holborn, W.C.
Sept. 22, 1865	Geddes, P., Millbank, Westminster, S.W.
Jan. 28, 1870	Gellatly, Peter, Loughton, Essex.
July 26, 1867	George, Edward, F.R.M.S., 12, Derby-villas, Forest-hill, S.E.
Mar. 22, 1867	George, Henry, 65 Castle-street, Oxford-market, W.
July 22, 1870	Gibson, Joseph F., 3 Furnival's-inn, E.C.

Date of Election.	
June 14, 1865	Gibson, W., 9 Lupus-street, Pimlico, S.W.
Aug. 23, 1867	Gilbert, C. H. D., 65 Ludgate-hill, E.C.
Nov. 22, 1867	Golding, W. H., 19 Regina-road, Tollington-park, N.
Dec. 23, 1870	Goldsmith, John Charles, 5 America-square, E.C.
Nov. 25, 1870	Goldsmith, S. J., St. George's-hospital, S.W.
Oct. 26, 1866	Gooch, James W., 23 High-street, Eton.
Dec. 22, 1865	Goode, W., 8 Bath-terrace, Lavender-hill, Wandsworth-road.
Feb. 22, 1867	Gosling, W., Edgecumbe-villa, Upper Tooting, S.W.
Mar. 27, 1866	Gray, S. Octavus, 44 Doughty-street, W.C.
Dec. 22, 1865	Gray, W. J., M.D., F.R.M.S., 41 Queen Anne-street, Cavendish-square, W.
Feb. 25, 1870	Gray, Henry J., 5 Lower Craven-place, Highgate-road, N.W.
Jan. 28, 1870	Green, Nathaniel E., 3 Circus-road, St. John's-wood, N.W.
Oct. 28, 1870	Greene, Wm. Asbury, Parkshot, Richmond, Surrey.
Jan. 22, 1869	Greenfield, Basil E., 6 Gordon-square, W.C.
Oct. 23, 1868	Greenish, T., F.R.M.S., 20 New-street, Dorset-square, N.W.
Oct. 23, 1868	Gregory, Henry R., 10 Edith-grove, Fulham-road, S.W.
May 25, 1866	Griffiths, A. W., 41 Clerkenwell-green, E.C.
July 24, 1868	Groves, J. W., 25 Charlotte-st., Bedford-sq. W.C.
July 24, 1868	Grubbe, E. W., C.E., 49 Queen's-gardens, Hyde-park, W.
Jan. 27, 1871	Guimaraens, Augustus de Souza, 120, Ossulton-st., Euston-square, N.W.

June 14, 1865	Hailes, Henry F., 7 Harringay-road, Hornsey, N.
Aug. 26, 1870	Hailstone, Robert H., 35, Walworth-road, S.E.
Aug. 23, 1867	Hainworth, John, 138 Camden-road, N.W.
Feb. 23, 1867	Hainworth, W., Jun., Clare-villa, Cricketfield-rd., Lower Clapton.
Mar. 19, 1869	Hall, Marshall, F.G S., F.C.S., New University Club, St. James's-street, S.W.
Dec. 28, 1866	Hallett, R. J., Hawthorn-cottage, Kilburn, N.W.

Date of Election.	
Oct. 26, 1866	Halley, Alexander, M.D., 7 Harley-street, W.
Feb. 22, 1869	Hammond, A., 3 Alexander-road, Marine-town, Sheerness.
Oct. 22, 1869	Harcourt, Cyril B., 35 St. George's-square, S.W.
June 14, 1865	Hardwicke, Robert, F.L.S. (*Treasurer*), 192 Piccadilly, W.
Feb. 22, 1869	Harker, John W., F.R.M.S., 24 Upper Barnsbury-street, N.
Sept. 28, 1866	Harkness, W., F.R.M.S., Laboratory, Somerset-house, W.C.
Jan. 22, 1869	Harper, J., 5 Blenheim-villas, Selhurst-road, South Norwood.
June 23, 1871	Harris, Edward, 54, Hatton-garden, E.C.
May 22, 1868	Harris, W. H., F.C.S., Buckby Wharf, Northamptonshire.
Aug. 24, 1866	HART, ERNEST, 42, Harley-street, W.
Oct. 26, 1866	Hart, G. W., Mengeham-house, Hayling, Havant.
Nov. 26, 1869	Hart, Edward, Highbury New-park.
Aug. 23, 1867	Harvey, Wm., 38 Dale-road, Haverstock-hill, N.W.
June 28, 1867	Hawksley, Thos. P., 4 Blenheim-street, New Bond-street, W.
June 24, 1870	Hawkins, Samuel J., 2, Upper Park-road, Colney-hatch, N.
May 27, 1870	Haywood, Henry, Dartmouth-terrace, Rotherhithe, S.E.
Aug. 28, 1868	Heawood, Francis R. H., 80, Mark-lane, E.C.
Jan. 25, 1867	Heisch, Charles, F.R.M.S., South-villa, Hampstead-heath, N.W.
Aug. 23, 1867	Helm, Henry J., F.R.M.S., The Laboratory, Somerset-house, W.C.
Aug. 26, 1870	Hennell, Col. S., F.R.M.S., Ventnor-villa, Ventnor, Isle of Wight.
June 26, 1868	Henry, A. H., 49 Queen's-gardens, Hyde-park, W.
May 22, 1868	Hicks, J. J., 8 Hatton-garden, E.C.
Nov. 24, 1868	Hide, T. C., 46, Fenchurch-street, E.C.
June 14, 1865	Highley, S., F.G.S., 10A Great Portland-street, W.
Sept. 24, 1869	Hilton, J. D., M.D., Upper Deal, Deal, Kent.
Dec. 17, 1869	Hill, D. W., 78, Highbury New-park, N.
May 22, 1868	Hill, W. T., 4 Trinidad-place, Liverpool-road, N.

Date of Election.	
Sept. 28, 1866	Hind, F. H. P., 4 Pall-mall-east, S.W.
May 26, 1871	Hinton, Chas. Howard, 18, Savile-row, W.
Aug. 26, 1870	Hirst, John, Jun., F.R.M.S., Dobcross, near Manchester.
Aug. 4, 1865	Hislop, W., F.R.A.S., 177 St. John-street-road, Clerkenwell, E.C.
Dec. 23, 1870	Histed, Edward, 27, Haymarket, S.W.
Oct. 26, 1866	Holdernesse, W. B., 12 Park-street, Windsor.
May 22, 1868	Holdsworth, Joseph, 54 Lombard-street, E.C.
Mar. 22, 1867	Holmes, Samuel, 12 Brunswick-terrace, Lower-road, Rotherhithe, S.E.
July 24, 1868	Holmes, W., M.R.C.S., 1 Brighton-villas, Lower Norwood, S.E.
April 27, 1866	Holtzapffel, J., A.I.C.E., 5 Great Coram-st., W.C.
April 26, 1867	Hooton, C., 3 Horningston-villas, Junction-rd., N.
May 22, 1868	Hopkinson, J., F.R.M.S., 8 Lawn-road, Haverstock-hill, N.W.
July 23, 1869	Horn, William E., 50 Bessborough-street, S.W.
May 27, 1870	Horn, T. W., 6 Clarence-road, Finsbury-park, N.
Oct. 26, 1866	Horncastle, H., Edwinstowe, near Ollerton, Notts.
June 25, 1869	Houghton, W., Walthamstow, Essex.
April 26, 1867	Hovenden, F., 93 City-road, E.C.
Mar. 27, 1868	How, James, F.R.M.S., 2 Foster-lane, E.C.
Feb. 25, 1870	Hudleston, W. H., F.G.S., J.P., 23 Cheyne-walk, S.W.
Oct. 23, 1868	Hughes, R. H., B.A. Jesus Coll., Camb., 6 The Terrace, Putney, S.W.
June 25, 1869	Humphreys, Henry, B.A., 9 Amhurst-road-west, N.E.
Dec. 28, 1866	Hunt, W. H. B., F.R.M.S., 23 Eversholt-street, Oakley-square, N.W.
May 24, 1867	Hutchinson, F., M.D., 29 Woburn-place, Russell-square, W.C.
Nov. 25, 1870	Hutton, Rev. Wyndham M., Lezayre-vicarage, Ramsey, Isle of Man.
May 24, 1867	Ingpen, John E., F.R.M.S., 7 Putney-hill, S.W.
June 23, 1871	Isaac, Thomas, Maldon, Essex.

Date of Election.	
Dec. 17, 1869	Jackson, B. D., 2 Morland-villas, Gresham-road, Brixton, S.W.
July 24, 1868	Jackson, F.R., Maple-villa, West Dulwich, S.E.
June 14, 1865	Jaques, Edward, F.R.M.S. (*Librarian*), Woods and Forests Office, Whitehall, S.W.
June 26, 1868	Jeakes, Lt.-Colonel, Winchester Hall, Highgate, N.
Jan. 27, 1871	Jefferson, Henry, Eldon House, Clapham-common, S.W.
April 23, 1869	Jefferson, Thomas, 17 The Pavement, Clapham-common, S.W.
July 24, 1868	Jennings, Rev. Nathaniel, M.A., F.R.A.S., 66 Avenue-road, Regent's-park, N.W.
Jan. 24, 1868	Jewell, C. C., 2 Great Queen-street, W.C.
July 22, 1870	Johnson, F., Barnsbury House School, Islington, N.
Jan. 25, 1867	Johnson, John A., 15 Wellington-road, Stoke Newington, N.
Oct. 28, 1870	Johnson, Arthur J., St. Thomas's Hospital, S.E.
Feb. 24, 1871	Johnson, M. Hawkins, F.G.S., 379 Euston-road, N.W.
Jan. 26, 1866	Johnson, R. G., Horbury-villa, Ladbroke-square, Notting-hill, W.
Mar. 24, 1871	Johnstone, James, Jun., 14, Lordship-park, Green-lanes, N.
Mar. 19, 1869	Jonas, L. E., 13, Canterbury-villas, Maida-vale, N.W.
Nov. 25, 1870	Jones, Major Lewis, United Service Club, Pall-mall, S.W.
Dec. 18, 1868	Jordan, James B., 11 Grafton-square, Clapham, S.W.

Oct. 26, 1866	Kemp, Robert, 25 Junction-rd., Uppor Holloway, N.
Oct. 26, 1866	Kent, W. S., F.R.M.S., F.Z.S., The Geological Department, British Museum, and 16 Tavistock-street, Bedford-square, W.C.
Jan. 27, 1871	Kesteven, W. B., F.R.C.S., 401, Holloway-rd., N.
June 14, 1865	Ketteringham, T., 51 Coleshill-street, Eaton-sq., S.W.
Aug. 23, 1867	Kiddle, Edward, The War Office, Pall-mall, S.W.

Date of Election.	
Mar. 19, 1869	Kilsby, Thomas W., Upper Fore-street, Edmonton, N.
July 7, 1865	King, G. H., 190 Great Portland-street, W.
July 22, 1870	King, Henry, 65, Myddelton-square, W.
Dec. 23, 1870	King, Robert, Fern House, Upper Clapton, E.
April 26, 1867	Kirk, Joseph, 11 Blossom-st., Norton Folgate, N.E.
June 24, 1870	Knaggs, Henry G., M.D., 49 Kentish-town-road, N.W.
Oct. 23, 1868	Knevett, S., 18 Montague-street, Russell-sq., W.C.
Nov. 25, 1870	Ladd, Wm., F.R.A.S., 12, Beak-street, Regent-street, W.
July 27, 1866	Lambert, T. J., 151 Highbury New-park, N.
Nov. 23, 1866	Lambert, W., 4 New Basinghall-street, E.C.
Aug. 24, 1866	Lampray, John, F.R.G.S., F.A.S.L., F.R.M.S., 16 Camden-square, N.W.
Mar. 22, 1867	Lancaster, Thos., Bownham-house, Stroud, Gloucestershire.
July 22, 1870	Lang, Alfred Graham, Guy's Hospital, S.E.
Dec. 28, 1866	Langrish, H., 250, Pentonville-road, N.
Aug. 4, 1865	LANKESTER, EDWIN, M.D., F.R.S., F.L.S., F.R.M.S., Melton House, Child's-hill, Hampstead, N.W.
Feb. 26, 1869	Lavey, Charles, 2 Richmond crescent, Barnsbury, N.
Aug. 28, 1868	Lawson, Henry, M.D., 8 Nottingham-place, W.
June 25, 1869	Layton, Charles E., 8 Upper Hornsey-rise, N.
Aug. 28, 1868	LEAF, C. J., F.L.S., F.R.M.S., &c., (*Vice-President*) (*President of the Old Change Microscopical Society*), Old Change, E.C.
Mar. 19, 1869	LEE, HENRY, F.L.S., F.R.M.S., &c. (*Vice-President*), The Waldrons, Croydon.
Oct. 25, 1867	Leifchild, J. R., M.A., 42 Fitzroy-street, Fitzroy-square, W.
Sept. 22, 1865	Leighton, W. H., 2 Merton-place, Chiswick, W.
June 25, 1869	Lemmon, Benj., 61, Hungerford-road, Islington, N.
May 28, 1869	Letts, Edmund A., Clare-lodge, Perry-hill, Sydenham, S.E.

Date of Election.	
Mar. 22, 1867	Lewinsky, John, 13 Frith-street, Soho, W.
Jan. 22, 1869	Lewis, Louis, M.R.C.S. 1 Rutland-street, Regent's-park, N.W.
April 27, 1866	Lewis, R. T., F.R.M.S. (*Hon. Reporter*), 1 Lowndes-terrace, Knightsbridge, S.W.
June 26, 1868	Lindley, W., Jun., Kidbrook-terrace, Blackheath, S.E.
June 25, 1869	Linford, John S., 146 Holborn-bars, W.C.
Dec. 17, 1869	Lloyd, Thos., 17 Holles-street, Cavendish-sq., W.
Nov. 24, 1865	Loam, Michael, Hampton, Middlesex, S.W.
May 26, 1871	Locke, John, 50, Bayham-street, Camden Town, N.W.
April 23, 1869	Long, Henry, 90 High-street, Croydon.
Jan. 26, 1866	Lord, J. K., F.Z.S., Elm-house, Denmark-hill, S.E.
Nov. 24, 1865	Lovibond, J. W., F.R.M..S, St. Anne-street, Salisbury.
Sept. 22, 1865	Lovick, T., Board of Works, Spring-gardens, S.W.
May 28, 1869	Lowe, Henry W., Heathfield, Sydenham-hill, S.E.
Dec. 18, 1868	Lowne, Benjamin Thompson, M.R.C.S., 99, Guildford-street, Russell-square, W.C.
April 27, 1866	Loy, W. T., F.R.M.S., 9 Garrick-chambers, Garrick-street, W.C.
Jan. 24, 1868	Macdonald, J., M.D., 68 Upper Kennington-lane, S.E.
Nov. 25, 1870	McHardy, M. M., St. George's Hospital, S.W.
Nov. 23, 1866	McIntire, S. J., F.R.M.S., 22 Bessborough-gardens, S.W.
Oct. 25, 1867	McLeod, R. G., Cowley Arms, Addison-place, Brixton-road, S.W.
May 22, 1868	McVean, W., 18 Wood-street, E.C.
June 14, 1865	Marks, E., 2, Brunswick-terrace, Harringay-road, Hornsey, N.
Dec. 28, 1866	Marsh, W. A., 325 Hackney-road, N.E.
June 26, 1868	Martin, James, 110 Regent-street, W.
Dec. 27, 1867	Martinelli, A., 106 Albany-street, N.W.
Oct. 25, 1867	Marwood, W. G. H., 68, Downham-road, Kingsland, N.

Date of Election.	
Dec. 22, 1865	Mason, J., Hampton, Middlesex, S.W.
April 26, 1867	Matthews, G. K., St. John's-lodge, Beckenham, Kent, S.E.
May 28, 1869	Matthews, Henry, 60 Gower-street, W.C.
Oct. 26, 1866	Matthews, John, M.D., 4 Mylne-street, Myddelton-square, E.C.
June 28, 1867	Matthews, Peter, L.D.S., F.Z.S., F.R.M.S., 17 Lower Berkeley-street, W.
Sept. 24, 1869	Matthews, William, 374 Camden-road, N.
Aug. 27, 1869	Mavor, William Samuel, 91 Park-street, Grosvenor-square, W.
May 26, 1871	May, John William, F.R.M.S., 9 Fairfax-road, St. John's-wood, N.W.
July 7, 1865	May, W. R., 20 Trinidad-place, Islington, N.W.
Mar. 22, 1867	Meacher, John W., 10 Hillmarten-road, Camden-road, N.
May 27, 1870	Medlock, Henry, M.D., 22 Tavstock-square, W.C.
Dec. 18, 1868	Mestayer, Richard, F.L.S., F.R.M.S., 7 Buckland-crescent, Belsize-park, N.W.
May 28, 1869	Millar, John, M.D, F.L.S., G.S., R.M.S., &c., Bethnal-house, Cambridge-road, N.E.
June 26, 1868	Milledge, Alfred, 4 Upper Winchester-road, Stanstead-road, Forest-hill, S.E.
Sept. 28, 1866	Miller, Benj., F.R.M.S., 17 St. James's-place, S.W.
July 7, 1865	Millett, F. W., 15 Alfred-street, River-terrace, N.
June 25, 1869	Moggridge, Matthew, F.G.S., 2 Montague-villas, Richmond, Surrey.
May 25, 1866	Moginie, W., F.R.M.S., 35 Queen-square, W.C.
Mar. 27, 1868	Moore, Daniel, M.D., High-street, Hastings.
Oct. 27, 1865	Morrieson, Colonel R., F.R.M.S., Oriental Club, Hanover-square, W.
July 26, 1867	Mott, H. H., 47 Union-grove, Clapham, S.W.
April 24, 1868	Mummery, J. Rigden, F.L.S., F.R.M.S., 10 Cavendish-place, W.
April 24, 1868	Mummery, J. Howard, 10 Cavendish-place, W.
Dec. 18, 1868	Mundie, George, M.R.C.S., 93 Richmond-road, Dalston, N.E.
Jan. 25, 1867	Murray, R. C., 69 Jermyn-street, St. James's, S.W.

Date of Election.	
Sept. 27, 1867	Nash, Thompson, 101 Mortimer-road, De Beauvoir square, N.
Mar. 23, 1866	Nation, W. J., 30 King-square, Goswell-road, E.C.
Mar. 24, 1871	Nelson, James, 2 Durham-place, Lambeth-road, S.E.
Jan. 26, 1866	Newman, W., 5 Oval-road, Kennington, S.E.
Dec. 18, 1868	Nicholas, T., Ph.D., F.G.S., 3 Craven-street, W.C.
July 7, 1865	Nicholson, D., 51 St. Paul's-churchyard, E.C.
Dec. 22, 1865	Nunn, C. G., Hampton, Middlesex, S.W.
April 26, 1867	Oakley, J. J., F.R.M.S., 183 Piccadilly, W.
Mar. 27, 1868	Oakeshott, John, High-street, Highgate, N.
May 26, 1871	Oriel, Chas. F., Oak-villa, Mattock-lane, Ealing, W.
Dec. 27, 1867	Osborn, C. E., 28 Albert-road, St. John's-ville, Highgate, N.
Dec. 27, 1867	Oxley, F., 3 Crosby-square, Bishopgate, E.C.
Nov. 27, 1868	Parker, T., 10 Brunswick-square, Camberwell, S.E.
April 22, 1870	Parker, Thos. J., 36 Claverton-street, S.W.
Dec. 17, 1869	Parker, William, M.D., 133 Grange-road, Bermondsey, S.E.
June 25, 1869	Pass, H., 11 Spring-terrace, Wandsworth-road, S.W.
May 26, 1871	Paxton, Rev. W. Archibald, M.A., Otterden Rectory, Faversham, Kent.
May 24, 1867	Pearce, G. T., 39 Clapham-road, S.W.
May 22, 1868	Pearsall, J. S., 5 Crescent-place, Clapham-common.
May 24, 1867	Pearson, John, 212 Edgware-road, W.
May 28, 1869	Pepler, W. B., Market Lavington, Wilts.
Oct. 25, 1867	Peppin, S. H., 25 Princes-st., Leicester-square, W.
Nov. 26, 1869	Perken, Edmund, 24 Hatton-garden, E.C.
July 23, 1869	Perry, F. J., 46 Bookham-street, Hoxton, N.
May 26, 1871	Pett, Edward Pattison, Lynden-villa, Tulse-hill, S.W.
Oct. 27, 1865	Pickard, J. F., 1 Bloomsbury-street, W.C.
Dec. 23, 1870	Piggott, G. W. Royston, B.A., M.D., 2 Lansdown-crescent, Kensington-park, W.

Date of Election.	
Jan. 22, 1869	Pillischer, M., F.R.M.S., 88 New Bond-street, W.
June 25, 1869	Pocock, Lewis, Jun., 70 Gower-street, W.C.
July 23, 1866	Pocock, Thos. Willmer, 10 Ampthill-square, N.W.
Feb. 22, 1867	Pollock, Timothy, M.D., F.R.C.S., 26 Hatton-garden, E.C.
Nov. 23, 1866	Potter, G., F.R.M.S., 42 Grove-road, Upper Holloway, N.
June 22, 1866	Powe, I., St. John's, Richmond, Surrey.
May 25, 1866	Powell, Hugh, F.R.M.S., 170 Euston-road, N.W.
July 7, 1865	Powell, Thomas, 18 Doughty-street, Mecklenberg-square, W.C.
Oct. 26, 1866	Praill, Edward, 39 Mornington-road, N.W.
Dec. 27, 1867	Preston, H. B., 1 Devonshire-road, Liverpool.
June 24, 1870	Preston, Francis W. H., 30 Warwick-gardens, Kensington, W.
Feb. 26, 1869	Prichard, Thomas, M.D., Abbington Abbey, Northampton.
Nov. 27, 1868	Pritchett, Benjamin, 131 Fenchurch-street, E.C.
July 26, 1867	Pritchett, Francis, 131 Fenchurch-street, E.C.
April 23, 1869	Quekett, Arthur Edwin, 13 Delamere-crescent, Westbourne-square, W.
April 23, 1869	Quekett, Alfred J. S., 13 Delamere-crescent, Westbourne-square, W.
April 23, 1869	Quekett, Rev. William, The Rectory, Warrington.
Feb. 23, 1866	Quick, George E., 109 Long-lane, Bermondsey, S.E.
Oct. 26, 1866	Rabbits, W. T., Selwood, Mayow-road, Forest-hill, S.E.
Nov. 23, 1866	Radermacher, J. J., 31 Lowndes-street, S.W.
Sept. 24, 1869	Radcliffe, J. D., 93 Albion-road, Dalston.
Oct. 26, 1866	Ramsbotham, J. M., M.D., 15 Amwell-street, Pentonville, E.C.
Oct. 26, 1866	Ramsden, Hildebrand, M.A., F.L.S., F.R.M.S., Forest-rise, Walthamstow, N.E.
Aug. 28, 1868	Rance, T. G., Widmore-lane, Bromley, Kent.
May 22, 1868	Rawles, W., 64 Kentish-town-road, N.W.

Date of Election.	
Oct. 28, 1870	Rean, Walter, Woodstock-road, Poplar, E.
July 7, 1865	Reeves, W. W., F.R.M.S., 37 Blackheath-hill, Greenwich, S.E.
Oct. 22, 1869	Rendle, J. B., M.D., Park-hill, Clapham.park, S.W.
May 26, 1871	Richards, Edward, 289 Camberwell-new-road, S.E.
Mar. 25, 1870	Richardson, Thos. Hyde, Raleigh-lodge, Devonshire-road, Forest-hill.
Jan. 24, 1868	Richardson, C. J., 44 Duncan-terrace, Islington, N.
Dec. 22, 1865	Richardson, C. T., M.D., 36 Dorset-square, N.W.
Feb. 23, 1866	Rixon, F., F.R,M.S., Loats-rd., Clapham-park, S.W.
June 25, 1869	Roberts, John H., F.R.C.S., F.R.M.S., 20 New Finchley-road, St. John's-wood, N.W.
May 22, 1868	Rogers, John, Elm-avenue, New Basford, near Nottingham.
Oct. 26, 1866	Rogers, Jos. R., 12 Bellefield-terrace, Bellefield-road, Stockwell, S.W.
Oct. 26, 1866	Rogers, Thomas, Mortlock-house, Loughborough-road, Brixton, S.W.
April 24, 1868	Rogerson, John, F.R.M.S., care of Mr. H. Crouch, 54 London-wall, E.C.
May 22, 1868	Roper, F. C. S., F.L.S., F.G.S., F.R.M.S., 157 Maida-vale, W.
July 24, 1868	Rowe, James, jun., M.R.C.V.S., 65 High-street, Marylebone, W.
Oct. 26, 1866	Rowlett, John, 8 Regent-street, S.E.
June 14, 1865	Ruffle, G. W. (*Curator*), 131 Blackfriars-road, S.E.
Mar. 22, 1866	Russell, Rev. F. W., F.R.M.S., Charing Cross Hospital, W.C.
Oct. 27, 1865	Russell, James, 4 Lansdowne-terrace, London-fields, Hackney, N.E.
Oct. 26, 1866	Russell, Joseph, F.R.M.S., Cumberland-lodge, Brixton-hill, S.W.
May 22, 1868	Russell, Thomas D., Patson Villa, Canterbury-rd., Brixton, S.W.
Feb. 22, 1867	Rutter, H. Lee, 1 St. Barnabas Villas, Lansdowne-circus, South Lambeth, S.W.
Dec. 17, 1869	Salmon, John, 24 Seymour-street, Euston-square.

Date of Election.	
Dec. 17, 1869	Sanders, Gilbert, Brockley-on-the-Hill, Monkstown, Dublin.
Nov. 22, 1867	Sanford, John, 30 Willes-road, Kentish-town, N.W.
July 28, 1871	Sansom, Arthur Ernest, M.D., 29 Duncan-terrace, Islington, N.
Dec. 18, 1868	Scantlebury, William, 7 Wells-street, Gray's-inn-road, W.C.
May 22, 1867	Scatliff, John Parr, M.D., 132 Sloane-street, S.W.
May 28, 1869	Scoble, Samuel W., 25 James-street, Covent-garden, W.C.
July 27, 1868	Sewell, Richard, Prince's-road, Lambeth, S.E.
July 27, 1866	Sharpey, W., M.D., F.R.S., 33 Woburn-place, W.C.
Oct. 22, 1869	Shaw, Wm. Foster, 50 Threadneedle-street, E.C.
Jan. 22, 1869	Sheehy, William H., M.D., 4 Claremont-square, N.
May 26, 1871	Sigsworth, J. C., 5 Jackson-road, Holloway, N.
Aug. 23, 1867	Simmons, James J., L.D.S., F.R.M.S., 18 Burton-crescent, W.C.
May 28, 1869	Simonds, Professor J. B., F.R.M.S., Royal Veterinary College, N.
Dec. 28, 1866	Simpson, G. Wharton, 36 Canonbury-park South, N.
Mar. 27, 1868	Simson, Thos., The Laurels, Courtyard, Eltham.
May 28, 1869	Sketchley, H. G., 10 Ampthill-square, N.
Dec. 28, 1866	Slade, J., 100 Barnsbury-road, N.
Oct. 23, 1868	Smart, William, 27 Aldgate, E.
May 25, 1866	Smith, Alpheus, 42 Choumert-road, Rye-lane, Peckham.
Mar. 25, 1870	Smith, Francis Lys, 3 Grecian-cottages, Crown-hill, Norwood.
Oct. 26, 1868	Smith, H. Ambrose, 2 King William-street, City, E.C.
June 26, 1868	Smith, James, F.L.S., F.R.M.S., 51 Gibson-square, Islington, N.
May 22, 1868	Smith, James John, F.R.M.S., 56 Tollington-road, N.
Dec. 23, 1870	Smith, Joseph A., London and County Bank, Newington, S.E.
April 23, 1869	Smith, Vernon, 37 Tavistock-square, W.C.
June 24, 1870	Smith, William, 1 Down-place, Hammersmith, W.

Date of Election.	
April 23, 1869	Snartt, T. G., 27 St. Paul's-road, Canonbury, N.
April 24, 1868	Snellgrove, W., 22 Surrey-square, S.E.
Sept. 22, 1865	Southwell, C., 44 Princes-street, Soho, W.
Dec. 18, 1868	Sowerby, D., 38 Albert-road, Dalston, N.E.
May 22, 1868	Spencer, John, Brooks's Bank, 81 Lombard-street, City, E.C.
Dec. 28, 1866	Spicer, Rev. W. W., F.R.M.S., care of the Rev. J. Bramhall, King's Lynn, Norfolk.
Nov. 23, 1866	Spurrell, F. C. J., F.R.M.S., Belvidere, Kent, S.E.
April 22, 1870	Stanley, Wm. Ford, Railway-approach, London-bridge, S.E.
May 26, 1871	Stapleton, Henry, 55 Beresford-road, Highbury-new-park, N.
Mar. 24, 1865	Starling, Benjamin, 11 Gray's-inn-square, W.C.
Aug. 24, 1866	Steward, J. H., F.R.M.S., 406 Strand, W.C.
Mar. 19, 1869	Stokes, Frederick, 31 Lincoln's-inn-fields, W.C.
Nov. 26, 1869	Stoker, George Naylor, F.R.M.S., Inland Revenue Office, Somerset-house, W.C.
July 1, 1866	Suffolk, W. T., F.R.M.S., Claremont-lodge, Park-street, Camberwell, S.E.
Nov. 22, 1867	Swainston, J. T., 17 Alfred-place, Thurloe-square, S.W.
Nov. 24, 1865	Swansborough, E., 6 Great James-street, Bedford-row, W.C.
June 24, 1870	Swain, Ernest, 89 Ladbroke-road, W.
Dec. 18, 1868	Swift, James, 43 University-street, W.C.
June 26, 1868	Syms, F. R., 4 Acacia-villas, Upper Richmond-road, Putney, S.W.
Nov. 25, 1870	Tafe, John Forwood, 34 Old Broad-st., City, E.C.
Nov. 22, 1867	Tarner, A. P., F.C.S., 97 High-street, Marylebone, W.
May 22, 1868	Tatem, J. G., Russell-street, Reading.
Dec. 22, 1865	Terry, J., 109 Borough-road, S.E.
May 28, 1869	Thairlwall, F. J., 169 Gloucester-road, Regent's-park, N.W.
July 23, 1869	Thin, James, Ormiston-lodge, Claremont-place, Brixton-road, S.W.

Date of Election.	
Feb. 24, 1871	Thornthwaite, W. H., jun., 122 Newgate-street, E.C.
Jan. 24, 1868	Tomkins, Samuel Leith, 26 Buckland-crescent, Belsize-park, N.W.
June 23, 1871	Topping, Amos, 28 Charlotte-street, Caledonian-road, N.
July 24, 1868	Tulk, John A., M.D., Spring-grove, Isleworth, W.
July 24, 1868	Tulk, John A., F.R.M.S., &c., Firfield, Addlestone, Weybridge.
July 26, 1867	Turnbull, Joseph, 1 Clifton-villas, Highgate-hill, N.
June 25, 1869	Turner, R. D., Chafford, Tunbridge.
Mar. 27, 1868	Tuson, Professor Richard V., Royal Veterinary College, N.W.
May 26, 1871	Unwin, Wm. Cawthorne, B.Sc., A.I.C.E., Homerton College, E.
July 27, 1866	Veitch, Harry, F.H.S., The Royal Exotic Nursery, King's-road, Chelsea, S.W.
Feb. 23, 1866	Walker, A., M.D., 17 Throgmorton-street, E.C.
May 28, 1869	Walker, Henry, 100 Fleet-street, E.C.
June 26, 1868	Walker, J. W., Fairfield-house, Watford.
Mar. 22, 1867	Wall, Alfred J., 46 Bessborough-st., Pimlico, S.W.
Dec. 18, 1868	Waller, Arthur, F.R.M.S., 11 Aberdeen-park, Highbury, N.
May 22, 1868	Waller, J. G., 68 Bolsover-street, Portland-rd., W.
Oct. 27, 1865	Wallis, George, South Kensington Museum, S.W.
Aug. 26, 1870	Warburton, Samuel, Merton-villa, New-road, Lower Tooting, S.W.
Nov. 22, 1867	Ward, F. H., Springfield-house, near Tooting, Surrey.
Dec. 18, 1868	Warner, Alfred, 93 Dempsey-street, Mile-end, E.
Feb. 26, 1869	Warner, William, 93 Dempsey-street, Mile-end, E.
May 25, 1866	Warrington, H. R., 7 Royal Exchange, Cornhill, E.C.

Date of Election.	
Oct. 27, 1865	Watkins, C. A., 10 Greek-street, Soho, W.
Sept. 22, 1865	Watson, T. G., 43 Poland-street, Oxford-street, W.
Sept. 25, 1868	Waugh, J. W. Spencer, 4 Maitland-park-villas, Haverstock-hill, N.W.
Dec. 28, 1866	Way, T. E., 65 Wigmore-street, W.
Jan. 22, 1869	Webb, George, 3 Crosby-square, Bishopsgate, E.C.
May 24, 1867	Weeks, A. W. G., 18 Gunter's-grove, Chelsea, S.W.
Dec. 22, 1865	West, W., 54 Hatton-garden, E.C.
Dec. 28, 1866	Wheldon, W., F.R.M.S., 58 Great Queen-street, W.C.
April 23, 1869	White, Charles Frederick, F.R.M.S., 42 Windsor-road, Ealing.
Oct. 26, 1866	White, F., 1 New-road, Commercial-road-east, E.
Feb. 26, 1868	White, Francis W., 2 Gipsy-hill-villas, Norwood, S.E.
May 22, 1868	White, T. Charters, M.R.C.S., F.R.M.S. (*Secretary*), 32 Belgrave-road, S.W.
May 24, 1867	White, W., F.R.M.S., 14 Park-terrace, Highbury, N.
July 24, 1868	Wight, James F., F.R.M.S., Gatcombe-villa, Croxted-road, West Dulwich, S.E.
May 22, 1868	Wigner, John M., B.A., B.Sc., 16 Grove-hill-terrace, Grove-lane, Camberwell, S.E.
Oct. 28, 1870	Williams, Martin G., 2 Highbury-crescent, N.
Mar. 24, 1871	Williams, George, 6 St. John's-park, Upper Holloway, N.
May 26, 1871	Williams, James W., 2 Elizabeth-terrace, Dalston, E.
July 28, 1871	Williams, Robert Pakenham, 2 Whitley-rd., Upper Holloway, N.
Jan. 25, 1867	Willsworth, H., 7 Whittington-terrace, Upper Holloway, N.
Feb. 23, 1866	Wilshin, J., 12 Totford-place, Neckinger, Bermondsey, S.E.
Feb. 22, 1867	Wilson, Frank, 110 Long-acre, W.C.
April 24, 1868	Withall, Henry, 1 The Elms, St. John's-road, Brixton, S.W.
May 28, 1869	Wood, Charles H., F.C.S., 25 Devonshire-road, Holloway, N.

Date of Election.	
Sept. 22, 1865	Wood, E. G., 74 Cheapside, E.C.
Aug. 27, 1869	Woods, W. Fell, 1 Park-hill, Forest-hill, S.E.
Oct. 25, 1867	Worthington, Richard, Champion-park, Denmark-hill, S.E.
Nov. 23, 1866	Wright, Edw., 89 Shepherdess-walk, E.C.
Aug. 4, 1865	Wyatt, C. C., 9 North Audley-street, W.
Oct. 26, 1866	Yeats, Christopher, Mortlake, Surrey, S.W.
Sept. 23, 1870	Yeoman, L. C. B., 21 Gutter-lane, E.C.
April 26, 1867	Young, J. T., 32 Mount-street, New-road, White-chapel, E.

RULES.

I.—That "The Quekett Microscopical Club" hold its meetings at University College, Gower Street, on the fourth Friday Evening in every month, at Eight o'clock precisely, or at such other time or place as the Committee may appoint.

II.—That the business of the Club be conducted by the President, four Vice-Presidents, the Treasurer, the Honorary Secretary, the Honorary Secretary for Foreign Correspondence, and a Committee of twelve other members. Six to form a quorum. That the Editor of the Journal be *ex officio* an additional member of the Committee. That the President, Vice-Presidents, Treasurer, and two Secretaries, with four senior members of the Committee (by election) retire annually, but be eligible for re-election.

III.—That at the ordinary Meeting in June, nominations be made of Candidates to fill the offices of Vice-Presidents and vacancies on the Committee. That such nominations be made by resolutions duly moved and seconded, no Member being entitled to propose more than one Candidate. That in the event of such nominations exceeding one half more than the number of vacant offices, the Candidates be reduced by show of hands to such proportion. That the President, Treasurer, Honorary Secretary, and Honorary Secretary for Foreign Correspondence be nominated by the Committee. That a list of all nominations made as above be printed in alphabetical order upon the ballot paper. That at the Annual General Meeting in July all the above officers be elected by ballot from the candidates named in the lists, but any member is at liberty to substitute on his ballot-paper any other name or names in lieu of those nominated for the offices of President, Treasurer, Honorary Secretary, and Honorary Secretary for Foreign Correspondence.

IV.—That in the absence of the President and Vice-Presidents the Members present at any ordinary Meeting of the Club elect a Chairman for that evening.

V.—That every Candidate for Membership be proposed by two or more Members, who shall sign a certificate (see Appendix) in recommendation of him—one of the proposers from personal knowledge. The certificate shall be read from the chair, and the Candidate therein recommended ballotted for at the following Meeting. Three black balls to exclude.

VI.— That the society include not more than twenty Foreign Honorary Members, elected by the Members by ballot upon the recommendation of the Committee.

VII.—That the Annual Subscription be Ten Shillings, payable in advance on the 1st of July, but that any Member elected in May or June be exempt from subscription until the following July. That any Member desirous of compounding for his future subscription may do so at any time by payment of the sum of Ten Pounds; all such sums to be duly invested in such manner as the Committee shall think fit. That no person be entitled to the full privileges of the Club until his subscription shall have been paid; and that any Member omitting to pay his subscription six months after the same shall have become due (two applications in writing having been made by the Treasurer) shall cease to be a Member of the Club.

VIII.—That the accounts of the Club be audited by two Members, to be appointed at the ordinary Meeting in June.

IX.—That the Annual General meeting be held on the fourth Friday in July, at which the Report of the Committee on the affairs of the Club, and the Balance Sheet duly signed by the Auditors shall be read. Printed lists of Members nominated for election as President, Vice-Presidents, Treasurer, Secretaries, and Members of the Committee having been distributed, and the Chairman having appointed two or more Members to act as Scrutineers, the Meeting shall then proceed to ballot. If from any cause these elections, or any of them, do not take place at this Meeting, they shall be made at the next ordinary Meeting, of the Club.

X.—That at the ordinary Meetings the following business be transacted:—The minutes of the last Meeting shall be read and confirmed; donations to the Club since the last Meeting announced

and exhibited; ballots for new Members taken; papers read and discussed; and certificates for new Members read; after which the Meeting shall resolve itself into a conversazione.

XI.—That any Member may introduce a Visitor at any ordinary meeting, who shall enter his name with that of the Member by whom he is introduced, in a book to be kept for the purpose.

XII.—That no alteration be made in these Laws, except at an Annual General Meeting, or a Special General Meeting called for that purpose; and that notice in writing of any proposed alteration be given to the Committee, and read at the ordinary Meeting at least a month previous to the Annual or Special Meeting, at which the subject of such alteration is to be considered.

APPENDIX.

FORM OF PROPOSAL FOR MEMBERSHIP IN

QUEKETT MICROSCOPICAL CLUB.

Mr.

of

being desirous of becoming a Member of this Club, we beg to recommend him for election.

(*on my personal knowledge*).

This Certificate was read 187

The Ballot will take place 187

RULES FOR THE EXCHANGE OF SLIDES.

I. That all Slides be deposited with the Exchange Committee.

II. That not more than two similar Slides be placed in the Exchange Box at one time by any one Member.

III. That the Slides be classified by the Committee into Sections, numbered according to quality.

IV. Members to select from the class in which their Slides are placed, at the ordinary meeting of the Club.

V. Members may leave the selection to the Exchange Committee, if they prefer it.

VI. Slides once exchanged cannot be exchanged again.

VII. A Register shall be kept, in which the Slides deposited shall be entered and numbered, with the date of receipt, and in which exchanges shall also be noted.

VIII.—All expenses incurred in the transmission of Slides or in correspondence respecting them, to be borne by the Member on whose account such charges may be incurred.

Parcels may be addressed—

Mr. T. Charters White,
192, Piccadilly,
London, W.
[Exchange.]

Note.—As much inconvenience frequently arises from the breakage of Slides in transmission through the Post, the following method is recommended:—Pack the Slides in a small wooden box, which can be obtained of any Optician, tie it securely with string and attach a slip of parchment to one end, sufficiently large to receive the Postage Stamps, Address, and local Post-office Stamps during transmission.

If paper be used as a wrapper to the box, the colour should be *black*.

When twelve or more Slides are sent, they should be packed in a racked ox and forwarded by Railway.

MEETINGS

OF THE

QUEKETT MICROSCOPICAL CLUB,

AT

UNIVERSITY COLLEGE, GOWER STREET, LONDON.

1871.—August	11	...	25
September	8	....	22
October	13	....	27
November	10	....	24
December	8	....	22
1872.—January	12	....	26
February	9	....	23
March	9	....	23
April	13	....	27
May	11	....	25
June	8	....	22
July	13	....	27

The Ordinary Meetings will be held on the second and fourth Friday Evenings, at Eight o'clock.

Extra Meetings for Conversation and Exhibition of Objects only, will be held on the second Friday of every month, at 7 o'clock, until further notice.

The Annual General Meeting will be held July 27th, 1872, at 8 o'clock, for Election of Officers and other business.

Offices, 192, Piccadilly, W.

Q. M. C.

EXCURSIONS, 1871.

April 15th	BARNES. To meet at Waterloo Station (Richmond line).
April 29th	WANDSWORTH COMMON. To meet at Clapham Junction, at 3 o'clock.
May 13th	CHISELHURST. To meet at Charing Cross Station.
May 27th	ELSTREE, returning by Edgware. To meet at St. Pancras Station, at 1.30 p.m.
June 10th	HOMERTON (for HACKNEY MARSHES), returning by Bow. To meet at Broad Street Station.
June 22nd	EXCURSIONISTS' ANNUAL DINNER. Arrangements will be duly announced.
June 1st	HAMPTON COURT. To meet at Waterloo Station (main line).
July 15th	BROMLEY (for KESTON). To meet at Ludgate Hill Station.
July 29th	BARNET (for TOTTERIDGE), returning by East End, Finchley. To meet at King's Cross Station.
Aug. 12th	THAMES DITTON. To meet at Waterloo Station (main line).
Aug. 26th	RAINHAM. To meet at Fenchurch Street Station.
Sept. 9th	VICTORIA DOCKS. To meet at Fenchurch Street Station.
Sept. 23rd	CROYDON (for ADDINGTON). To meet at London B. Station (Brighton line).
Sept. 30th	SNARESBROOK. To meet at Fenchurch Street Station.

The time of departure from Town, unless otherwise specified, will be THE FIRST TRAIN AFTER TWO O'CLOCK.

F. W. Gay,
W. W. Reeves,
W. T. Suffolk,
F. Oxley,
} Excursion Committee.

T. Charters White, Hon. Secretary,
Offices, 192, Piccadilly.

W. DAVY AND SON, PRINTERS, GILBERT STREET, W.